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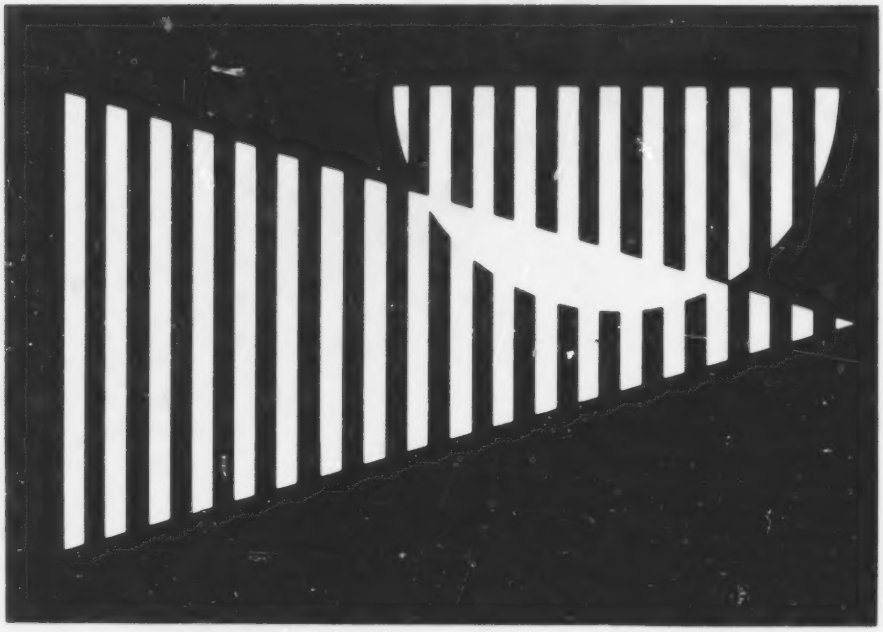
U.S. Small Business Administration
Office of Innovation Research and Technology

A Small Business Administration Report to The Congress

Second Year Results Under The Small Business Innovation Development Act of 1982 PUBLIC LAW 97-219



Office of Innovation, Research and Technology
2nd Annual Report
Report Number 453
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U.S. SMALL BUSINESS ADMINISTRATION
WASHINGTON, D.C. 20416

OFFICE OF THE ADMINISTRATOR

To the Chairman of the Senate and House of Representatives Committees on Small Business

This report, prepared pursuant to Public Law 97-219, discusses the second year results of the Small Business Innovation Development Act of 1982. The report presents and discusses the progress of the participating agencies under the Small Business Innovation Research Program and the agencies' achievement of small business goals under Research and Research and Development Acquisition. We have departed from traditional fiscal year reporting in this report. To more accurately show the results of the first year of the SBIR program, we have tracked the FY '84 solicitations, the number of proposals received, and the number of awards resulting from the FY '84 SBIR cycle. A number of the awards actually were made after the end of the fiscal year.

Copies of this report have been sent to the Office of Science and Technology Policy and the Office of Federal Procurement Policy.

James C. Sanders
Administrator

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Chapter I

Introduction

This report is the second in a series of annual reports presented by the Small Business Administration pursuant to Public Law 97–219. The law directs the SBA, among other things, to monitor, evaluate and report the progress and results of the Small Business Innovation Development Act of 1982 to the Congress. As with the first Annual Report, we have departed from traditional fiscal year reporting in this report. To more accurately show the results of the first and second year of the SBIR program, we have tracked the FY 83 and 84 solicitations, the number of proposals received, and the number of awards resulting from the FY 83 and 84 SBIR solicitation cycle. A number of awards for both FY 83 and 84 were made after the end of the fiscal year.

Public Law 97–219 amended the Small Business Act to strengthen the role of small, innovative firms in federally funded research and development, and to utilize Federal research and development as a base for technological innovation to meet agency needs and to contribute to the growth and strength of the nation's economy.

Findings and Purposes of the Small Business Innovation Development Act of 1982

The Congress after extensive hearings by several committees, lengthy debate, and expressed support by numerous constituents on all sides, overwhelmingly passed the Small Business Innovation Development Act and it was signed into law by the President on July 22, 1982.

The law states that Congress found that (1) tecnological innovation creates jobs, increases productivity, competition and economic growth, and is a valuable counterforce to inflation and the United States balance-of-payments deficit; (2) while small business is the principal source of significant innovations in the Nation, the vast majority of federally funded research and development is conducted by large businesses, universities, and Government laboratories; and (3) small businesses are among the most cost-effective performers of research and development and are particularly capable of developing research and development results into new products.

Based upon these findings the Congress stated the purposes of the Act are (1) to stimulate technological innovation; (2) to use small businesses to meet Federal research and development needs; (3) to foster and encourage participation by minority and disadvantaged persons in technological innovation; and (4) to increase private sector commercialization innovations derived from Federal research and development.

The Small Business Innovation Research (SBIR) Program and the Research and Research and Development Goaling Program

The law set into being two separate and distinct programs to be implemented beginning in Fiscal Year 1983. The primary program is the Small Business innovation Research Program (SBIR) and the secondary program is the Research and Research and Development Goaling Program.

Under the SBIR program, each agency with an extramural budget for research or research and development in excess of $100 million for Fiscal Year 1982 or any fiscal year thereafter shall establish an SBIR program. The program is funded by setting aside a set percentum of dollars during each fiscal year. This percentum will reach a maximum of 1.25. Civilian agencies have four years to reach the 1.25% and the Department of Defense is allowed five years. It is estimated that Fiscal Year 1987 funds will approximate $500 million. During the FY 83 implementation the civilian agencies set aside a percentum of 0.2 and the DOD a percentum of 0.1. During FY 84 civilian agencies set aside a percentum of .6 and the DOD a percentum of .3. This approximated $111 million for the SBIR program during FY 1984.

The participating agencies during FY 84 were as follows:

- Department of Agriculture
- Department of Commerce
- Department of Defense
- Department of Education
- Department of Energy
- Department of Health and Human Services
- Department of Interior
- Department of Transportation
- Environmental Protection Agency
- National Aeronautics and Space Administration
- National Science Foundation
- Nuclear Regulatory Commission

The Department of Commerce became the 12th agency to establish an SBIR program during FY 84 but was unable to issue a solicitation before the close of the fiscal year.

Under the law the SBIR program is a three phase process. The three phases are as follows.

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- **Phase I:** The majority of Phase I awards will be $50,000 (or a 1/2 person year) or less and will be made for research projects to evaluate the scientific and technical merit and feasibility of an idea.

- **Phase II:** As a result of Phase I, those projects with the most potential will be funded to further develop the proposed idea for one or two years and the majority of Phase II awards will be funded for $500,000 or less.

- **Phase III:** Private-sector investment and support will bring an innovation to the marketplace. When apropriate, this phase may also involve follow-on production contracts with a Federal agency for future use by the Federal Government. No SBIR funds may be utilized during Phase III.

The Research and Research and Development Goaling Program

The law requires agencies with a budget for research or research and devlopment in excess of $20 million for any fiscal year, beginning with Fiscal Year 1983, to establish small business goals for awarding R&R&D funding agreements. The goal to be set annually cannot be less than an agency's achievement during the fiscal year.

In addition to the aforestated SBIR agencies, the following Federal agencies participate in the goaling program:

- Department of Justice
- Department of Housing and Urban Development
- Agency for International Development
- Smithsonian Institute
- Tennessee Valley Authority
- Veterans Administration

Small Business Administration Authorities and Responsibilities

The law designated the SBA as the agency for program implementation, governing policy and monitoring and analysis of Agency program performance. The SBA's authorities and responsibilities are as follows:

1. Developing, coordinating, issuing and updating a Policy Directive for the Federal government-wide conduct of the SBIR program.

2. Developing and administrating an SBIR program information and outreach program.

3. Developing and maintaining a mailing list file of interested small business innovative firms.

4. Developing, coordinating, publishing and disseminating for the public SBIR pre-solicitation announcements.

5. Surveying, monitoring and reporting on agency SBIR programs.

6. Reporting at least annually to Congress on SBIR programs and SBA monitoring efforts.

7. Coordinating with the private sector on the commercialization aspects of SBIR innovations.

Participating Agency SBIR Program Authorities and Responsibilities

The authorities and responsibilities of the participating agencies are as follows:

1. Unilaterally determine categories of projects to be in its SBIR program.

2. Issue SBIR solicitations in accordance with a schedule determined cooperatively with the Small Business Administraion.

3. Unilaterally receive and evaluate proposals resulting from SBIR solicitations.

4. Unilaterally select awardees for its SBIR funding agreements.

5. Administer its own SBIR funding agreements (or delegate such administration to another agency).

6. Make payments to recipients of SBIR funding agreements on the basis of progress toward or completion of the funding agreement requirements; and

7. Make an annual report on the SBIR program to the Small Business Administration and the Office of Science and Technology Policy.

The SBIR Program Policy Directive

The Small Business Administration was directed to develop, publish and implement a policy directive for the general conduct of the program within one hundred and twenty days of enactment of the law. The SBA was to consult with the Administrator of the Office of Federal Procurement Policy, the Director of the Office of Science

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and Technology Policy and the Intergovernmental Affairs Division of the Office of Management and Budget. The law further directed that the policy directive provide for a simplified, standardized and timely SBIR solicitation process and that the program should minimize the regulatory burden associated with participation in the SBIR program. The law further directed this process to specific acquisition topics. These topics included timely receipt and review of proposals, peer review, proprietary information, selection of awardees, data rights retention, title to government property, cost sharing and cost principles.

Survey, Monitoring and Reporting

Pursuant to the legislation the SBA is to independently survey and monitor operation of SBIR programs within participating Federal Agencies. The law directs the SBA to report not less than annually to the Committee on Small Business of the Senate and the Committee on Small Business of the House of Representatives on the SBIR programs of the Federal agencies and the SBA's information and monitoring efforts.

To support this reporting requirement, the agencies are directed to make an annual report of their SBIR activities to the SBA.

In addition to SBA's reporting requirements, the law directs the Office of Science and Technology Policy to make an annual report and the General Accounting Office is to make a report no later than the fifth year of the enactment of the law.

Sunset Provision

The law provides that as of October 1, 1988 the Small Business Innovation Act of 1982 will be repealed unless extended by the Congress.

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Chapter II

Administrative Actions

To implement the Small Business Innovation Development Act of 1982, the SBA designed and developed a simplified and standardized solicitation process for the SBIR program. The new process represented a profound change for the participating agencies and small businesses. The new SBIR solicitation process was to be implemented and operational during Fiscal Year 1983. The agency responsible for the design, coordination and implementation was the Small Business Administration. The responsibility also included a national information and outreach campaign. The controlling document to be developed was a policy directive that delineated the program policy and acquisition process for the general conduct of the SBIR program by the participating agencies. Additionally, the law directed that each Federal agency with a research and research and development budget in excess of $20 million for any fiscal year beginning in FY 83 to establish goals for awarding R&R&D funding agreements to small business concerns. The goal established is not to be less than the percentage of the total R&R&D budget awarded to small business in the preceding fiscal year.

The SBIR Program Policy Directive

The law directed that the Small Business Administration after consultation with the Administrator of the Office of Federal Procurement Policy, the Director of the Office of Science and Technology Policy, and the Intergovernmental Affairs Division of the Office of Management and Budget would within one hundred and twenty days of the enactment of the Law issue policy directives for the general conduct of the SBIR program. In addition to the legislated coordination, the SBA established an advisory council of high technology small businesses, solicited comments from the participating agencies and obtained public comment through the Federal Register. As directed by the Act, the first policy directive was published and issued on November 19, 1982.

The first policy directive provided the needed guidance to the SBIR participating agencies for Fiscal Year 1983. On August 1, 1983 and on September 30, 1984 the SBA published revised policy directives. Both revisions were coordinated as prescribed by the law and published in final form in the Federal Register.

SBIR Mailing List

In order to assure qualified and interested small business concerns the opportunity to submit proposals to the agency solicitation topics, the SBA developed a name and address mailing list system. The information for the mailing list is collected through the SBA SBIR program pamphlet which presents a general explanation of the program and a tear-off mail-in card for application to the SBIR mailing list system. During FY 83 approximately 140,000 copies of the pamphlet were disseminated throughout the country. The FY 83 mailing list grew to over 40,000. This figure was far beyond any initial estimates and represented a clear indicator of the nationwide interest in the program.

The FY 83 mailing list was stored at the Government Printing Office on a semi-mechanical system. The system gave SBA no capability to search, purge or provide timely special runs. During the latter part of FY 83 the SBA contracted with a small business firm to purge and convert the mailing list to a computerized system. This new system provided SBA with higher accuracy, purge capability and many other capabilities. The system was fully purged and converted by March, 1984. Presently the SBIR list contains approximately 30,000 names and addresses and the system has proven to be highly reliable.

Pre-Solicitation Announcements

During FY 83, the SBA published six pre-solicitation announcements. Approximately 340,000 copies of the announcements were disseminated throughout the country. In FY 84, four pre-solicitation announcements were printed and distributed, one prior to the beginning of each fiscal year quarter. Over 200,000 pre-solicitation announcements were distributed during FY 84.

The pre-solicitation announcements are of considerable assistance to the public in that they present the basic solicitation information on all agency SBIR solicitations in a succinct and understandable presentation. Each publication provides complete information on all quarterly SBIR activity and eliminates the need for small business people to track the activities of each participating agency.

The pre-solicitation announcement is published and distributed prior to the release dates of agency solicitations. The announcements provide small businesses with a brief statement of each agency research topic, the opening and closing dates of each solicitation, an estimate of the number of awards to be made under each solicitation, who to contact for a copy of the agency solicitation and a master schedule of agency opening and closing dates. To

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date the response from the public to these pre-solicitation announcements has been excellent.

Public Information and Outreach

The SBA has continued its efforts to make the SBIR program known to the largest possible technology oriented audience. This effort included participation in conferences and seminars, developing and coordinating news releases, television and radio interviews, development and dissemination of a program pamphlet, contact and interaction with small business associations and minority and disadvantaged outreach programs.

During the fiscal year the SBA provided SBIR program speakers at seminars and conferences. These seminars and conferences were sponsored by states, cities, universities, associations, Members of Congress and private firms. The structural content of seminars and conferences changed during the second year of the program. The content has changed from basic program information to detailed discussions of program elements. SBA field representatives have taken a larger role in this area. It is estimated that total seminar and conference attendance exceeded 12,000. This type of effort will continue in Fiscal Year 1985.

During the past fiscal year the SBA provided press releases to over 350 news outlets throughout the nation. The SBIR program was the subject of a half hour Small Business Report, aired on the American Business Network reaching a cumulative audience of 42 million.

The SBA continued to publish an SBIR program pamphlet during Fiscal Year 1984 and distributed 155,000 copies. The pamphlet, in addition to providing program information, also serves as a mechanism for mailing list development. The SBA field offices have been furnished a supply of the pamphlets and will continue to be a primary source of this type of outreach.

In order to meet the demand for speakers throughout the country, the SBA utilized an audio/visual program which presents a detailed explanation of the program. We believe that this program is an excellent teaching and explanation tool for the SBA regional and district offices' use in seminars and conferences.

An example of the different types of outreach by the SBA include formal program briefings to foreign governments. During FY 84, the SBIR staff provided formal briefings to 47 foreign visitors from 10 countries.

Commercialization Matching System

Because many investors are interested in SBIR firms working on potentially lucrative and commercially feasible research and development projects, SBA has developed a computerized data base to link potential sources of capital with SBIR awardees. This "Commercialization Matching System" provides technical abstracts of SBIR projects to possible investors, and provides awardees with the names of companies (venture capitalists, large corporations) that would consider such investments. Selections are made on the basis of technology and industry preferences, geographic preferences, and dollar thresholds. At this time, over 1,500 SBIR projects and 350 capital sources are listed in the data base, and SBA is actively publicizing the availability of this valuable and necessary service.

Minority and Disadvantaged Outreach

The SBA participated in two minority conferences during FY 84. One was held in Philadelphia at the University of Pittsburgh and one in Atlanta at Atlanta University. The Atlanta conference was co-sponsored by the SBA and the National Aeronautics and Space Administration. Attendance at both of these seminars exceeded 200 people. During FY 85 it is anticipated that SBA minority outreach efforts will be intensified. An effort will be made to not just increase our data base of minority-owned firms, but to identify minority firms capable and interested in competing in the SBIR program.

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Chapter III

SBIR Acquisition Data

Reporting Agencies

Section 4(f)(1) of P.L. 97–219 directed each agency with an extramural R&D budget of $100 million or more to establish a Small Business Innovation Research program. Agencies that are presently required to establish SBIR programs are:

- Department of Agriculture
- Department of Commerce
- Department of Defense
- Department of Education
- Department of Energy
- Department of Health & Human Services
- Department of Interior
- Department of Transportation
- Environmental Protection Agency
- National Aeronautics & Space Administration
- National Science Foundation
- Nuclear Regulatory Commission

Beginning with FY 83, each agency establishing an SBIR program was to set aside a set percentage of its extramural R&R&D budget for award to small business through the SBIR program. Through a phased in process over a four year period, civilian agencies are required to increase the percentage set-aside for SBIR from .2% in FY 83 to 1.25% by FY 1986. DOD was allowed five years to phase in the program and was required to set aside .1% in FY 83 and reach 1.25% by FY 87. During FY 84 the DOC became the twelfth particpating agency but was not able to release a solicitation prior to the end of FY 84. DOC issued its first solicitation in early FY 85, and its SBIR Budget for FY 85 will include the .2% deficit from FY 84 and the .6% required amount for FY 85.

Section 4(h) of P.L. 97-219 required each agency with a total Research and Research and Development (R&R&D) budget of $20 million or more to establish goals for awarding R&R&D funding agreements to small business. Each goal established was to at least be equal to that percent of the agency total R&R&D budget that was awarded to small business during the immediately preceding fiscal year. Including the twelve SBIR agencies, 18 agencies are presently required to establish R&R&D small business goals. The additional six agencies are:

- Agency for International Development
- Department of Justice
- Housing and Urban Development
- Smithsonian Institute
- Tennessee Valley Authority
- Veterans Administration

Each agency required by Sections 4(f) and 4(h) to establish an SBIR program or R&R&D small business goal is to report annually to the SBA "the number of awards pursuant to grants, contracts and cooperative agreements over $10,000 in amount and the dollar value of all such awards, identifying SBIR awards and comparing the number and amount of such awards with awards to other than small business." Consistent with this legislative requirement, this Chapter provides a statistical report of the acquisition activity for agencies establishing SBIR Programs and R&R&D Goaling programs for Fiscal Year 1984.

Reporting Requirements — SBIR Program

To properly monitor and report on the participating agencies' SBIR programs, it was necessary for the SBA to establish a reporting base to compare against each agency's budget data. In determining extramural R&R&D obligations as a base for the size of the SBIR programs, the Act provided a definition of research and development identical to that in the Office of Management and Budget (OMB) Circular A-11 on the "Preparation and Submission of Budget Estimates," which is the basis of total R&R&D obligations given in Special Analysis K: "Research and Development in the Budget of the United States Government." Agencies subsequently submit to the National Science Foundation breakdowns of total R&R&D obligations into intramural and extramural R&R&D obligations, which are published in "Federal Funds for Research and Development," now in its thirty-third year of publication.

For agencies with SBIR programs, SBA reviews the NSF data and uses as an extramural base for SBIR, that amount determined by the agency to be its extramural budget. A distinction between intramural and extramural is not made nor necessary for agencies participating in the R&R&D goaling program since the agency goal is based upon total R&R&D budget obligations.

Due to the three year budget cycle in estimating extramural R&R&D obligations, and consequent changes in the SBIR bases, some difference between SBIR required expenditures and actual expenditures are to be expected. Because of this late final expenditure and base reporting, SBA uses a system of deficits and credits for adjusting future years. Thus the SBIR agencies proceed on the best

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available estimates and ultimately through adjustments achieve the percentages specified by the law.

The revised September 1984 Policy Directive required that the following SBIR information be provided to the SBA in the agencies' Annual Reports.

1. Agency total fiscal year, for FY 1983 and each year thereafter, extramural research and research and development total budget authority as reported to the NSF pursuant to Special K of the United States Budget.

2. SBIR program total fiscal year dollars derived by applying the statutory percentum of the agencies extramural research and research and development total budget authority.

3. SBIR program fiscal year dollars obligated through SBIR program funding agreements for Phase I and Phase II.

4. Number of SBIR individual solicitations released during the fiscal year and the number of topics and subtopics contained in each solicitation.

5. Number of copies of each SBIR solicitation distributed by the participating agency.

6. Number of proposals received by the agency for each topic in each SBIR solicitation.

7. For both Phase I and II the SBIR awardee's name and address, solicitation topic and subtopic, solicitation number, project title, and total dollar amount of funding agreement. Identify minority and disadvantaged small business, women-owned small business and Phase II awardees with a follow-on funding commitment.

8. For an agency Phase III award using non-SBIR Federal funds, to continue a Phase II project, the agency shall provide the name, address, project title and dollar amount obligated.

Agency reports were to be submitted to the SBA no later than 90 days after the end of the fiscal year (December 30, 1984). The agency reports have been analyzed and summaries are presented in Exhibits 3.1–8. The Exhibits have been designed to present the following information:

1. SBIR Agency Total Expenditure Summary
2. SBIR Solicitation Profile
3. SBIR Award Profile
4. Geographic Distribution of Awards
5. SBIR FY 83/84 Comparison
6. R&R&D Goaling Agencies Achievement Data
7. Effect of Multiple Awards
8. FY 83/84 Awardee Analysis

SBIR Agency Total Expenditure Summary

Exhibit 3–1 is a comparison of the total dollars awarded by the eleven SBIR agencies during FY 84. Total SBIR dollars awarded for Phase I and Phase II were $111.5 million; $67 million more than was awarded in FY 83. Dollars awarded are compared to the SBA estimated extramural and SBIR program budgets. The SBA estimated extramural R&R&D budgets are based upon each agency's budget submission to the National Science Foundation and the Office of Management and Budget.

Agency estimated extramural and SBIR budgets are not used for comparison due to the fact that many agency estimates are inconsistent with their submissions to OMB and NSF. SBIR extramural base dollars have been resolved with all agencies except the Department of Defense and Department of Transportation. During FY 84 deficits were mainly the results of the three year budget cycle. At the beginning of each fiscal year, SBA provides each agency with its estimates (based upon NSF data) of the agency extramural and SBIR budget. This estimate will change during the year to reflect actual obligations incurred one year prior, revised obligations for the immediate FY and estimated obligations for the new year. Thus, there are two estimates from which the agencies must work. From a programmatic standpoint, to ensure proper implementation, each agency establishes its budget and proceeds during the year on that budget. Adjustments are then able to be made in the following year.

Five agencies had deficits for FY 84, but only the DOD and DOT deficits can be considered significant. SBA estimates that the DOD deficit will continue to grow each year due to DOD's decision not to include its 6.6 test and evaluation funds into its extramural R&R&D budget base. SBA estimates this deficit will grow from $9 million in FY 84 to $35.6 million in FY 85.

DOT reflects a deficit for both FY 83 and FY 84. Cumulatively this deficit is $1.2 million. DOT maintains that their data reported to NSF is incorrect and that certain R&R&D funds should be excluded from the agency extramural base. Other agencies with deficits for FY 84 are the U.S. Department of Agriculture, Department of Education, and Environmental Protection Agency.

The DOC deficit for FY 84 though not shown in Exhibit 3–1 is a result of the agency being unable to release a so-

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licitation prior to the end of FY 84. Their FY 84 deficit of $207,814 has been included in DOC's FY 85 SBIR Budget.

Five agencies (DOE, DOI, HHS, NSF, and NRC) realized a surplus for FY 84 totaling $2,375,800. Of these agencies, HHS and NSF also had a surplus in FY 83.

A deficit or surplus for NASA is not shown due to the fact that NASA's SBIR Budget is based upon appropriations that are higher than the amount actually required by the statutory percentage.

Solicitation Profile

Exhibit 3–2 presents the SBIR agencies basic acquisition demographics for FY 84. A total of fourteen SBIR solicitations were released during FY 84. One for each agency, and four for HHS. The four HHS solicitations included two from the Public Health Service, one from the Human Development Services and one from the Health Care Financing Administration.

Approximately 7,955 Phase I proposals were received in response to the FY 84 solicitations which resulted in 999 Phase I awards. Although Phase I proposals decreased from 8,814 in FY 83 to 7,955 in FY 84, Phase I awards increased from 686 to 999. In addition, while the percentage of Phase I awards to proposals was 7.9 in FY 83, this percentage increased to 12.6 for FY 84.

FY 84 also produced 559 Phase II proposals, from the FY 83 Phase I awardees, resulting in 338 Phase II awards. Thus of the 686 FY 83 Phase I awardees, 49.2% received Phase II awards.

Excluding the 4 solicitations from HHS, an average of 78.3 days was allowed for proposal submission.

Award Profile

Exhibit 3–3 provides an analysis of the total SBIR dollars awarded during FY 84. Approximately $48 million was awarded for Phase I during FY 84 and approximately $63.4 million for Phase II. Total dollars awarded during FY 84 are approximately $111.5 million. This total includes $3 million awarded by DOD to complete some prior DESAT awards. Total dollars awarded represent an increase of $67 million over the total awarded during FY 83.

Minority/Disadvantaged owned firms received 87 Phase I awards and 40 Phase II awards in FY 84. Phase I awards to minorities were approximately 9.98% of all Phase I awards and 11.8% of Phase II awards.

Phase I dollars awarded to minority/disadvantaged firms totaled $4.1 million representing 9.8% of all Phase I dollars. Phase II dollars awarded to minority/disadvantaged were $9.4 million representing 15.5% of all Phase II dollars. Overall, minority firms received 10.5% of all FY 84 SBIR awards and 11.1% of all FY 84 SBIR dollars.

It should be noted that at the time of reporting, NASA had not completed its FY 84 Phase I awards. Therefore, data on minority participation for Phase I excludes the number and dollars of NASA Phase I awards. Data on minority achievement for Phase II include the number and dollars for NASA Phase II awards. Finally, data pertaining to the total minority participation for FY 84 excludes Phase I and Phase II awards and dollars from NASA and excludes $3,020,000 DESAT dollars from DOD.

The average amount of Phase I awards generally was lower than the $50,000 limit. DOD was the highest with an average of $53,600 and ED was the lowest with an average of $28,900. Since Phase II awards are incrementally funded over a two-yer period, an average award amount for the first year of Phase II is not included.

Geographic Distribution

Exhibits 3–4 A & B detail SBIR activity for each state. Exhibit 3–4 A lists the total number of awards, minority awards and total dollars awarded to each state for FY 84. Exhibit 3–4 B lists the same data on a cumulative basis for FY 83 and 84. The number and dollar value of awards in Exhibit 3–4 B include both Phase I and Phase II. This distribution excludes NASA Phase I awards.

Exhibit 3–5 is designed to provide a brief summary of SBIR activity for FY 83 as compared to FY 84. It is not intended to provide a basis for evaluating any SBIR agency. Phase II data is excluded in this exhibit since there is no comparative data for FY 83.

New Companies

Current acquisition data suggests that the SBIR program provides new opportunities for small business firms. Less than one fourth of the companies who received Phase I awards in Fiscal Year 1984 received Phase I awards in Fiscal Year 1983 (See Exhibit 3.7). This trend is even more dramatic when individual agencies are considered (Exhibit 3.8). On the average, only 15% of FY 84 awardees received prior year awards from the same agency.

As seen in Exhibit 3.7, companies that were multiple award winners in FY 84 were more likely to have been award winners in FY 83 (51% to 14%). Multiple award

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winners in FY 84 are also more likely to have received multiple FY 83 awards (22% to 3%) than the single award winners.

R&R&D Goaling Agencies

P. L. 97–219 in addition to establishing an SBIR program also required each agency with a total research and development budget of $20 million or more to establish a Small Business Research & Research & Development Goaling Program. The law required that any goal established could not be less than the percentage awarded to small business in the immediately preceding fiscal year.

Including the twelve participating agencies in FY 84, six additional agencies were required to conduct a goaling program in FY 84. These six agencies included:

- Agency for International Development
- Department of Housing and Urban Development
- Department of Justice
- Smithsonian Institution
- Tennessee Valley Authority
- Veterans Administration

Pursuant to P. L. 97–219, the SBA required each agency through the revised September 1984 Policy Directive to provide the following information in its annual report to the SBA.

1. Agency previous fiscal year's total R&R&D dollar authority.

2. Agency previous fiscal year's total R&R&D obligated dollars to small business, minority and disadvantaged small businesses and women-owned small business under funding agreements and the percentage to the agency's total R&R&D dollar authority.

3. Agency current fiscal year total R&R&D budget authority.

4. Agency current fiscal year total R&R&D small business goal based on the percentage of awards to small businesses made the previous fiscal year.

5. Current fiscal year achievement of the singular small business R&R&D goal and the dollars obligated through prime funding agreements by categories of small business, minority and disadvantaged small business and women-owned small business.

6. The total number and dollar value of R&R&D awards to small business over $10,000 for contracts, grants, and cooperative agreements and compare such awards to awards to other than small business for the same above categories.

During FY 83, of the 18 reporting agencies, seven provided complete data, six provided incomplete data and five failed to report any data. Although all agencies required to report, were cognizant of the requirements of P. L. 97–219, the SBA Policy Directive, and the necessary information to report, SBA was informed by some agencies that they did not maintain acquisition data on certain funding agreements.

To address this problem, SBA contacted each agency in early FY 84 and requested the agency to designate a goaling representative, and provide SBA with the FY 84 percent goal and the agency's total R&R&D budget estimate.

The SBA then held two meetings with agency representatives concerning the goaling program requirements and the information to report to SBA. New draft reporting formats were provided to each agency for comment.

Based upon SBA's efforts, there was an improvement in the number of agencies reporting and the data reported.

In FY 84 twelve agencies reported, two agencies' reports were incomplete and four agencies failed to report. The Agency for International Development failed to report in FY 84 as it did in FY 83, and the Veterans Administration did not report FY 84 data. HUD did not report for FY 84 maintaining that its R&R&D budget dropped below the $20 million threshold and thus it was no longer required to establish goals. Department of Education failed to report any data in FY 83 and the data reported for FY 84 was incorrect.

Total dollars awarded under the Goaling program for FY 84 were approximately $1,254.7 million excluding awards for ED, HUD, AID and VA. As a result of the inadequate data reported in FY 83 and 84, it is impossible to determine if total dollars awarded actually increased or decreased for these years. SBA has not drawn any conclusions in this report pertaining to the number and dollar value of awards for contracts, grants, and cooperative agreements to small business as compared to awards other than small business. The limited information provided by the agencies precludes any interpretation of the data.

Overall, there is still a discrepancy between the agencies total R&R&D budgets as reported to SBA compared to their data reported to NSF and OMB. Because of this difference, it is difficult to evaluate the agencies achievement of their percent goal. Evaluation of the agency goal is

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compounded because some agencies based their goal upon extramural awards instead of the total budget awards as required by the law.

Exhibit 3–6 details the goaling activity for the 18 goaling agencies and presents the agency percent goal as stated in the agency FY 84 annual report, the SBA estimated dollar goal, agency total dollars awarded to small business, minority/disadvantaged small business; the percent of the agency R&R&D budget awarded to small and minority/disadvantaged small business and the agency activity for contracts, grants, and cooperative agreements over $10,000. The following provides a summary of the agency reported goaling data for FY 84.

Total Dollars Subject to Goaling (000)	$43,136,400
*Total FY 84 Dollar Goal (000)	$2,038,405
Total FY 84 Dollars Awarded to Small Business (000)[1]	$1,254,747
*Total FY 84 Total Percent Goal	4.73%
*Percent Awarded to Small Business for FY 84	2.91%
*Percent of Goal Achieved	61.5%
Total Dollars Awarded to Minority/Disadvantaged (000)[2]	$160,970
Percent Awarded to Minority/Disadvantaged	.37%

Ten agencies (DOC, DOE, DOI, DOT, EPA, HHS, NASA, NRC, NSF, and TVA) met or exceeded their goal. Four agencies did not report (ED, AID, HUD, VA) and three agencies (DOA, DOD, DOJ) failed to achieve their goal. SI did not report its percent goal.

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*Excludes ED; AID; HUD; VA; SI
[1]Excludes ED; AID; HUD; VA
[2]Excludes DOA; ED; AID; HUD; SI; VA

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Chapter IV

Technical and Commercialization Aspects of the SBIR Program

The SBIR program has now completed its second year, yet it remains too early to assess its impact on the purposes of the Small Business Innovation Development Act (SBIDA): technological innovation and commercialization. The first set of companies has been selected for Phase II awards for continued research and development. For most of them, two years will elapse before Phase III, where marketing and production efforts accompanied by increased employment and growth are anticipated. Nevertheless, in this Chapter, we shall attempt to review the participation of the Federal agencies and small firms with these purposes in mind. It should be noted that our presentation of the technical and commercialization elements of the SBIR program exclude data from the National Science Foundation. At the time of reporting NSF was in the process of negotiating FY 84 Phase I awards.

Solicitation Topics

SBIR solicitation topics in fiscal year 1984 continued to cover the entire spectrum of science and technology. Exhibit 4.1 presents a list of technology areas which is useful in describing SBIR solicitation topics and awards.

SBA's review of the agency SBIR solicitations shows that in the majority of agencies, most of the research topics are either new or substantially modified. This indicates that, overall, the participating agencies are attempting to identify and communicate appropriate topics for SBIR research and development.

Last year, SBA distinguished four categories of solicitation topics according to how specifically the agency describes the result it is seeking from the research and development effort (see Exhibit 4.2 for definitions). All topics were assigned to one of these categories and the distribution is shown in the following table:

		FY 83	FY 84
I.	Specific product identified	351	365
II.	Problem identified	361	582
III.	Research area identified	365	476
IV.	Study needed	44	55

Where in the first year of the program, there was an even distribution among the first three categories, we now observe a growth in categories II and III relative to category I. In both years the number of awards in each category was roughly proportional to the distribution. This shift toward categories II and III is viewed as a positive development for the proposing companies as it allows them more discretion in determining what products will result from the research efforts.

Topics in category IV identified such needs as state-of-art surveys, general studies of developments in a particular field, or routine tests of existing products. Compared to other SBIR efforts, it is difficult to see how such studies could lead to technological innovation, and it is encouraging to see that the number of these topics has remained small.

Distribution of Awards Among Technology Areas

Exhibit 4.3 summarizes, for each agency, the amount of FY 84 Phase I award funding that can be attributed to the various technology areas.* Only the technology categories represented by the first two digits of the technology codes in Exhibit 4.1 are shown. Also note that, in deriving these data, each SBIR project was assigned to as many technology categories as were applicable. Exhibit 4.4 shows the same distribution graphically for the total program. Exhibits 4.5 and 4.6 show similar distributions for the FY 84 Phase II awards.

In Exhibit 4.7, the FY 84 Phase I and Phase II awards are compared to the FY 83 Phase I awards (recall that this is the group from which the Phase II awards were selected) in the most general technology categories. Overall, the FY 84 Phase I distribution is nearly identical to the FY 83 Phase I distribution, with the exception of a slight shift from the Energy to the Environmental area. The Phase II distribution is also very similar except for a shift from Life Sciences to the Energy area.

However, within these general technology areas more subtle changes from last year's distribution can be distinguished from the Phase I comparison in Exhibit 4.8. The Systems Studies area has grown at the expense of Information Processing. (This development is of concern because many projects in the former area are state-of-the-art type surveys with little or no innovative thrust; however, the total dollars in this area remain relatively small.) In

*The data in these exhibits was developed by SBA based on the technical abstracts and dollar amount of awards provided by the participating agencies. In some cases, where information was incomplete, approximations have been made.

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Electronics, Optical Devices and Lasers have received increased attention, while in Materials, developments aimed at new Specialty Materials have grown at the expense of Materials Peformance/Fatigue. In the Energy area, the percentage in fundamental Transport Sciences has grown largely at the expense of Electric Power, and in Life Sciences, the former dominance of Medical Instrumentation over Biotechnology/Microbiology has disappeared.

The more detailed comparison of the FY 84 Phase II awards to the FY 83 Phase I awards is shown in Exhibit 4.9. The only significant differences are in Materials, where Materials Processing/Manufacturing has grown at the expense of Materials Performance/Fatigue, and in Mechanical Performance, where Aerodynamics has surpassed Hydrodynamics.

On the whole, the FY 84 SBIR technology distributions remain very similar to the FY 83 distribution. As SBIR represents the R&D interests of a diverse set of Federal agencies, it is not surprising that the awards are distributed throughout a full spectrum of science and technology areas.

Comparison to Venture Capital Investment

The ultimate success of the SBIR program will depend on the ability of participating small companies to attract private sector funds for follow-on marketing, production, and distribution after the research and development efforts in Phases I and II.

As the distributions in Exhibits 4.3 through 4.6 can be regarded as a *de facto* "investment strategy" for SBIR, it is instructive to compare this SBIR technology distribution with a similar distribution for private sector investment. For this purpose, technology based companies which have received financing from the organized venture capital community (including independent venture capital firms, venture capital subsidiaries of banks and industrial corporations, and Small Business Investment Companies which engage in venture capital financing) were categorized using the same set of technology codes.* Exhibit 4.10 shows the percent of funds allocated by the venture capital community to each technology area for the years 1982–1984. A comparison of venture capital investment to the FY 84 SBIR Phase I awards is shown in Exhibit 4.11. It is seen that venture capital investment is very highly focused compared to SBIR. Except for relatively small financings in Life Sciences and Materials, nearly all venture capital investments are in Computer, Communications, Information Processing, and Electronics. As seen in Exhibit 4.12, venture capital is also more focused geographically than SBIR, with California receiving over 50% of venture capital investment but under 25% of SBIR awards.

While SBIR firms will need follow-on funding to commercialize the results of their SBIR efforts, it should be realized that many firms are working in technical areas which have not recently attracted substantial venture capital. This is not unexpected: SBIR attempts to contribute to both agency R&D needs, which cover the full spectrum of science and technology, and commercialization, which requires private sector investment. Venture capital is only one measure of potential private sector financing for SBIR follow-on funding, but it is an important measure because it supports companies which are similar in many respects to SBIR firms desiring to move to Phase III.

In order to overcome this barrier, agencies must maintain a commitment to the commercialization goals of SBIR. One mechanism is to encourage companies to submit third phase, non-Federal capital commitments with their Phase II proposals. (The SBIDA provides that agencies use such commitments in evaluating proposals of approximately equal scientific and technical merit.) Companies should also be encouraged to look beyond the venture capital community for follow-on funding, e.g., to larger corporations.

Phase I Projects

In accordance with its surveying and monitoring responsibilities, SBA has reviewed all SBIR technical abstracts and has visited a substantial sample of Phase I participants during fiscal year 1984. On the whole, the majority of Phase I firms appear to be participating as intended by the Small Business Innovation Development Act (SBIDA): they have identified a technical barrier to a perceived market need, are pursuing Phase I research to show the scientific and technical feasibility of their ideas, are planning for continued R&D in Phase II (in most cases leading to a prototype product), and have identified a strategy for Phase III commercialization.

There also appears to be a non-trivial and possibly growing number of Phase I projects whose relation to the intended purposes of the SBIDA is questionable. These fall into two main categories:

(1) Projects seeking to address fundamental scientific concerns with little or no attention to Phase III. These awards may be related to an imbalance in proposal evaluation criteria: i.e., considerations of agency need overly dominating considerations of commercialization potential.

*These data were developed by Ventura Economics, Wellesley Hills, Massachusetts, under contract to the Small Business Administration.

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(2) Projects with minimal technical risk where SBIR efforts are focused, not on scientific/technical feasibility, but on identifying user needs. Many of these projects are studies of existing situations with little or no thrust toward technological innovation.

Such questionable projects are awarded by most SBIR agencies. The awarding of these projects may result from attempts to balance SBIR funding among the agencies' sub-units, even though some have programs which are less conducive to SBIR-type efforts.

It is SBA's opinion that neither of the above categories is appropriate for SBIR and that, if such projects are important to the agencies' missions, they should be supported by non-SBIR funding mechanisms. Based on our sample, about 20% of the Phase I projects appear to fall into these categories; however, many are screened out in the Phase II process, thus reducing the percentage of questionable projects by about half. While the resulting level may be tolerable for a program of this scope, an increased awareness is required to insure that the number of such projects remains small.

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Chapter V

Administrative Issues

The second year of the Small Business Innovation Development Act can be best described as one of expansion and maturity. In the first year, the basic program elements were implemented. These included the program Policy Directive, the pre-solicitation announcement, the mailing list, the solicitation process, outreach techniques and materials, the award of Phase I funding agreements and the annual report. In the second year of the program, expenditures more than doubled, Phase II awards were made, the mailing list was computerized, the conferences and seminars matured from fundamentals to specific topic discussions, agency SBIR program procedures were refined and the SBA Commercialization Matching System to link venture capital dollars to SBIR awardees was completed. It is the SBA's view that for the most part, all the major objectives of the program have been accomplished to date. As with last year's report, the SBA would like to take the opportunity to express its views concerning the SBIR and Goaling programs. The comments are not in any order of significance but do represent our view as of December 31, 1984.

Administrative Funding For SBIR

During FY 84, some agencies were forced to lessen their outreach efforts due to limited staff and administrative funding. This curtailment is expected to continue to some degree in FY 85, particularly in the agencies with smaller programs. As the program's dollars under SBIR increase each year, the administrative burden for program management and administration also increases but with no funded administrative resources.

Outreach efforts for the SBIR program are a necessary activity for SBA and the participating agencies. In particular, travel for seminars and conferences and limited staff may become a problem.

Phase II Funding Gap

The lapse of time between the end of the Phase I project and the Phase II award could become a problem. Several agencies and awardees have expressed concern regarding this time lag. The time range may be from three to four months to a year. SBA intends to monitor this time frame and review with the agencies various potential solutions.

Follow-on Funding

The Small Business Innovation Development Act (SBIDA) directs "where appropriate, a third phase in which non-Federal capital pursues commercial applications of the research and development and which may also involve follow-on non-SBIR production contracts with a Federal agency for products or processes intended for use by the United States Government." To stimulate commercialization, the law further requires that, "where two or more (Phase II) proposals are evaluated as being of approximately equal scientific and technical merit and feasibility, special consideration shall be given to those proposals that have demonstrated third phase, non-Federal capital commitments."

There is difficulty in implementing this requirement due to multiple interpretations of the phrase, "approximately equal scientific and technical merit and feasibility" and the agencies differing technical proposal evaluation methods. For example, in one agency Phase II proposals are divided into broad groupings. The top group (usually about ten percent) are considered to be clearly excellent and automatically receive Phase II awards. The next group, those proposals considered to be very good, contains the majority of proposals. Finer distinctions within this group are not made because of the difficulty in comparing the merits of proposals in different scientific and technical disciplines. This relatively large group of proposals are therefore considered to be approximately equal, and special consideration is given to those with non-Federal capital commitments. In some other agencies, a scoring system is used in evaluating proposals, and those with the best scores receive awards until no funds remain. Only those proposals which are at or very near the cutoff score (often fewer than five percent of the proposals) are considered to be approximately equal for the purpose of considering the capital commitments.

Because of these difficulties in interpretation, the agencies differ in the degree to which they encourage and what they require from companies to pursue sources of follow-on funding. SBA has found that these differences are confusing to many small firms who deal with more than one SBIR agency. Therefore, the SBA intends to review with the agencies the commitment letter format and its use in the funding agreement process.

The SBIR agencies through the Policy Directive have been asked to provide copies and data of these commitments so that SBA can track this process and review for possible standardization. All agencies are providing or have agreed to provide such data except the Department of Energy.

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R&R&D Goaling Program

After two years of program performance the R&R&D Goaling program has not been completely implemented by the responsible agencies. In FY 83 seven of the eighteen goaling agencies reported their fiscal year end acquisition data. In FY 84 twelve agencies reported complete data. Two problems exist which prevent implementation: the first being that some agencies are unable to establish their R&R&D base and some of the agencies apparently do not have an acquisition reporting system for certain small business R&R&D funding agreements. Because of this inability of the agencies to report, the SBA is unable to give an opinion on small business R&R&D awards in any given fiscal year.

Agency Extramural Obligations

During FY 84, the SBA continued to experience problems concerning agencies R&R&D extramural obligations that are subject to the legislated percentum requirements. In particular, DOT and DOD are the agencies where there is disagreement over the agencies extramural obligations. DOD continues to maintain that its 6.6 test and evaluation funds should be excluded from its extramural base. This exclusion is the cause of a DOD deficit of $9 million for FY 84 and a projected deficit of $35.6 million in FY 85. Although the 6.6 funds do meet the program definition of Research and Development, SBA has not been able to resolve this problem with DOD.

DOT on the other hand maintains that the DOT information reported to NSF was incorrect and based upon DOT analysis, certain funds should be excluded from their extramural R&R&D. SBA has made numerous efforts with DOT to resolve this problem but has been unable to reach an agreement. It is SBA's opinion that the DOT position is incorrect and the reported funds are actually part of the DOT extramural base until budget changes are agreed to and made at OMB and NSF.

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Chapter VI

An SBIR Technology Sampler

In this chapter, a number of SBIR projects are presented to convey what is actually happening in the SBIR program. These projects were chosen to illustrate the diverse technologies and geographical regions involved in SBIR and do not represent any attempt to identify those with the greatest expectations for success. All of these projects have recently begun or will soon begin Phase II of the SBIR program.

Rimstar Systems, Tucson, Arizona (HHS)

In glaucoma, loss of vision results from damage to optic nerve fibers as they leave the eye. As fibers deteriorate, the shape of the nervehead changes and it becomes hollowed out or cupped. Presently, only qualitative evaluations of the degree of change from normal can be made. The purpose of this project is to produce an automated device which could precisely and reproducibly map the three dimensional contour of the nervehead, allowing ophthalmologists to diagnose very early glaucoma and accurately follow the progress of its treatment. The technical effort applies principles of optics and image analysis and must account for the unique properties of the living eye: several biological layers through which light passes, susceptibility to movement and light-induced damage.

Spire Corporation, Bedford, Massachusetts (DOE)

The commercial viability of photovoltaic systems depends critically on system cost and efficiency, with a minimum operating module efficiency of about 15% required to compete in the U.S. energy market. During Phase I, the feasibility of using the ion implantation process for fabrication of cells with unusually high efficiency on small-area (4cm^2) cells made from single crystal silicon was shown, and a large-area (50cm^2) cell was designed. Phase II addresses fabrication of prototype large-area cells, reduction of process cost, and application of the cell design and fabrication process to solar cells made from a number of present day silicon sheet materials. The resulting processes will lead to a superior flat-plate solar cell and will be critically important to establishing viable solar electric technology.

Chemical Process Corporation, Milwaukee, Wisconsin (EPA)

The company will develop a production method for using waste whey to make thermosetting resins used in such products as particle board and plywood. In Phase I, press conditions were established to produce good quality boards from a mixture of wood particles, resin, and low concentrations of a poly-functional cross linking agent. The Phase II work will optimize resin production by quantifying the relation among chemical composition, reaction kinetics, and adhesive properties. This effort has three simultaneous benefits: (1) the whey waste is high in sodium chloride and consequently presents a difficult disposal problem; (2) in the resins, the whey substitutes for formaldehyde which is a known source of indoor air pollution; and (3) the total cost of the resin is expected to be significantly reduced.

Bonneville Scientific, Salt Lake City, Utah (NASA)

Because of the expense and complexity of manned space flights it is desirable to perform many NASA space missions, such as satellite servicing and construction, by teleoperator control of space-based robotic systems. Although vision systems provide crucial information, both tactile information and reaction force-torque measurements are mandatory for full capability. As current multiaxis force-torque sensors are expensive and bulky, this project addresses the design of a miniature six-component force-torque sensor mounted in the fingertips of a teleoperator or robot hand. Forces and torques are sensed by applying ultrasonic pulse-echo ranging to measure the deformation of elastomers applied to the gripping surface. Phase II will involve cooperative activities with robot manufacturers, and applications to automated manufacturing processes are expected.

Genetic Diagnostics, Great Neck, New York (DOA)

Trichothecene mycotoxins may appear in foodstocks and cause serious illness and death in animals and humans. The USDA and agricultural companies require a technique for rapid detection and quantification. Current methods are highly specialized procedures, use trained personnel in a laboratory setting, and can take weeks to determine if silage is contaminated (during which time toxins can spread). The purpose of this effort is to identify a monoclonal antibody, which selects and adheres to the mycotoxin, and an enzyme attached to the antibody which causes the release of color in the presence of the toxin. Both flourescent and colorimetric assay protocols are being evaluated for field (non-laboratory) measurements, which may have further applications to the analysis of herbicides, pesticides, and other agricultural pollutants.

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Computer Technology Associates, Englewood, Colorado (DOD)

The process of developing and maintaining computer software is one of the fastest growing expenses in the procurement of DOD weapon systems. The promise for alleviating this problem lies in automating as much of the software process as possible, particularly focusing on those areas which are labor intensive. The ultimate objective of this effort is to build a data flow diagram editor/compiler that will enable functional software developers to compose programs graphically and have the corresponding functional "code" generated automatically. The end result will be a collection of software tools that will support the translation and execution of programs in a high level language.

Verax Corporation, Hanover, New Hampshire (NSF)

Verax is developing technology to reduce costs in producing high value biochemicals (e.g. monoclonal antibodies and mammalian-cell products) which offer promise in the diagnosis and treatment of cancer, arteriosclerosis, AIDS, arthritis, and diabetes. Conventional batch processes work discontinuously with much down time for cleanup, sterilization, and incubating a new colony of cells for each cycle. This effort has helped establish the feasibility of continuous fermentation in a fluidized slurry of beads composed of immobilized microorganisms in a fibrous matrix. Culture nutrients have been optimized to yield matrix cell concentrations 10 to 100 times denser than conventional cell cultures allowing order of magnitude increases in monoclonal antibody production with commensurate capital cost savings. These achievements have already led to production contracts with several large pharmaceutical and genetic engineering companies.

Epsilon Lambda Electronics Corporation, Geneva, Illinois (DOT)

The purpose of this project is to produce a working prototype and a manufacturable design of a radar traffic sensor system for intersections. The sensor will replace wire loops and loop amplifiers traditionally installed in the street to provide traffic flow information to the traffic control computer. The Phase I effort has identified appropriate frequency and other sensor characteristics and has established signal processing algorithms. The system, consisting of a microwave sensor mounted on the traffic light crossarm with associated electronics and cables, will be capable of providing velocity information in addition to presence and passage information available from the loop sensors. Economic benefits will result from lower installation and maintenance costs and ease of reconfiguration or upgrade.

Audiological Engineering Corporation, Somerville, Massachusetts (HHS)

There are approximately 2 million persons in the United States alone who are considered to be profoundly deaf. This SBIR project is developing a device which uses the sense of touch, tactile discrimination, to assist these children and adults with the understanding of speech. Spoken words are felt as a series of pressure pulses on the skin. The Phase I effort identified perceptual thresholds and designed a vibrotactile transducer with associated processing electronics. In Phase II, a miniature wearable aid will be developed and tested. The deaf child or adult with appropriate training will be enabled to more effectively communicate with hearing persons.

Remote Technology Corporation, Oak Ridge, Tennessee (NRC)

This project is targeted toward commercializing robotic application engineering services and robotic inspection equipment products for nuclear power plants. The robotic system will replace human workers in performing visual and audible inspections and radiation mapping within controlled areas. The Phase I study produced a cost effective approach, and Phase II includes the design, construction, and demonstration testing of an inspection robotic system at the Browns Ferry Nuclear Plant. The objective is to obtain operating experience and hard cost/benefit data to demonstrate that robotics can reduce occupational radiation exposure and be cost-effective.

Microwave Monolithics Incorporated, Simi Valley, California (NASA)

Switch matrices aboard communications satellites transfer information from an upcoming beam to a beam directed toward any one of several possible earth locations. Although the need for more communications links with greater capacity and versatility in both military and commercial sectors is rapidly increasing, conventional circuit technology for switch matrices results in a heavy, costly subsystem with many discrete components. A detailed Phase I design analysis has shown the feasibility of building a monolithic, gallium arsenide, intermediate frequency (IF) switch matrix, which is an integrated circuit of microwave components. Phase II is concerned with construction of the switch matrix, interface with other systems components, and experimental verification. The concept is expected to find use in a wide variety of airborne or ground based systems due to its small size, light weight, and low cost potential.

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Scientific Research Associates, Glastonbury, Connecticut (DOD)

Efficient high performance compressors and turbines are required for modern advanced propulsion systems. Designers of such systems use numerical flow models to simulate operation and predict performance, but exorbitant computing costs limit the effective use of these models. In Phase I, a flow prediction procedure has been restructured to permit shorter computer run times and to allow efficient utilization by a relatively inexperienced user. Under Phase II, the code would be vectorized, allowing another order of magnitude reduction in the convergence of the calculations. Ultimately, it is expected that this effort will lead to the development of a computer aided design tool for use by aircraft engine manufacturers.

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EXHIBIT 3-1
FY 84 SBIR AGENCY TOTAL EXPENDITURE SUMMARY

Agency	DOA	DOD	DOE	DOI	DOT	ED	EPA	HHS	NASA	NRC	NSF	TOTALS
Agency Extramural Budget (000)	$295,928	19,865,804	4,523,532	114,890	422,681	120,394	152,462	3,721,090	1,628,305	168,963	1,100,655	32,114,704
Agency SBIR Budget (000)	$ 1,776	53,638	15,616	689	2,536	722	915	22,327	13,400[1]	1,014	6,604	119,237
FY 84 SBIR $ Awarded (000)	$ 1,678	44,584	16,393	806	1,677	694	853	23,320	13,400	1,144	6,965	111,514
Percent of SBIR Dollars to Extramural Budget[2]	.57	.23	.37	.71	.40	.58	.56	.63	.83	.68	64	
FY 84 Deficit/Surplus (000)	$ -97	-9,054	+776	+116	-859	-28	-62	+993	NA[1]	+130	+360	-7,725
FY 83 Actual Deficit/ Surplus[3] (000)	$ -22	+5,153	-252	-9	-91	+111	-48	+664	NA[1]	-29	327	+5,604
Cumulative Deficit/ Surplus (000)	$ -119	-3,901	+524	+107	-1,150	+83	-110	+1,657	NA[1]	+101	+687	-2,121

[1]NASA SBIR budget is based upon appropriations which are higher than the required SBIR expenditures.
[2]Civilian agencies percent to extramural should be .6% and DOD should be .3% for FY 84.
[3]FY 83 Deficit/Surplus may differ from the FY 83 report since FY 83 budget data was estimated at that time.

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EXHIBIT 3-2
FY 84 SBIR PROGRAM SOLICITATION PROFILE

Agency	DOA	DOD	DOE	DOI	DOT	ED	EPA	HHS	NASA	NRC	NSF	TOTALS
Number of Solicitations Released	1	1	1	1	1	1	1	4[1]	1	1	1	14
Number of Research Topics in Solicitations	6	566	25	14	6	5	12	979[1]	15	4	18	1,650
Number of Subtopics in Solicitations	0	0	86	14	39	0	0	0[1]	157	18	0	314
Number of Copies Distributed (000)	3	42	15	4	7	2	2	17	10	2	13	117
Number of Days Allowed to Respond	121	94	63	72	79	50	60	NA	94	73	77	78.3
Number of Phase I Proposals Received	3281	3,010	844	110	366	234	136	921	919	110	977	7,955
Number of Phase II Proposals Received	12	151	96	4	6	7	8	95	92	7	81	559*
Number of Phase I Awards	16	368	101	13	17	13	10	226	127	6	102	999
Number of Phase II Awards	7	115	51	2	3	3	5	56	58	4	34	338
Percent of Awards to Proposals for Phase I Received	4.9	12.2	11.8	11.8	4.7	5.6	7.4	24.5	13.8	5.5	10.4	12.6
Percent of Awards to Proposals for Phase II Received	58.3	76.2	53.1	50.0	42.9	62.5	59.0	63.1	57.2	57.2	65.4	60.5

[1]Solicitation Data for HHS Includes Four Solicitations
NA-Not Applicable
*Of the 686 FY 83 Phase I winners, only 559 submitted Phase II proposals. If total Phase II awards are compared to total FY 83 Phase I winners, 49.2% would have received awards.

EXHIBIT 3-3
FY 84 AWARD PROFILE

Agency	DOA	DOD	DOE	DOI	DOT	ED	EPA	HHS	NASA	NRC	NSF	TOTALS
Total Phase I Proposals Received	328	3,010	844	110	366	234	136	921	919	110	977	7,995
Total Phase II Proposals Received	12	151	96	4	6	7	8	95	92	7	81	599
Total Phase I Awards	16	368	101	13	17	13	10	226	127	6	102	999
—Minority/Disadvantagd Phase I Awards	0	43	11	1	1	4	1	22	NA[2]	1	3	87[3]
Total Phase II Awards	7	115	51	2	3	3	5	56	58	4	34	338
—Minority Disadvantaged Phase II Awards	0	20	6	1	1	1	0	2	7	0	2	40
Total Phase I Dollars Awarded (000)	$678	19,736[1]	4889	419	813	373	353	10,610	6,400	267	3,482	48,020
—Total Minority/Disadvataged Phase I Dollars Awarded (000)	$0	2,261	543	35	50	120	36	904	NA[2]	49	105	4,103[3]
Total Phase II Dollars Awarded (000)	$1,000	21,786[1]	11,494	387	864	321	500	12,710	7,000	877	3,483	60,422
—Total Minority/Disadvantaged Phase II Dollars Awarded (000)	$0	3,816	1,483	137	300	120	0	543	2,864	0	88	9,351
Average Amount of Phase I Awards (000)	$42	54	48	32	48	29	35	47	50	45	34	

[1]Total Phase I and Phase II dollars awarded for DOD exclude $3 million awarded for DESAT awards.
[2]At the time of reporting, total minority dollars and number of awards for NASA were not available.
[3]Excludes minority Phase I dollars for NASA.

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EXHIBIT 3-4A
GEOGRAPHIC DISTRIBUTION
FY 84 PHASE I AND II SBIR AWARDEES

State	Number of Awardees	Dollar Amount	Number of Minority Awards	Minority Dollar Amount
Alabama	17	$2,805,221	5	$840,811
Arkansas	1	$214,193	0	$0
Arizona	8	$1,196,146	1	$185,000
California	253	$27,473,22	28	$4,630,559
Colorado	29	$2,109,146	3	$227,464
Connecticut	24	$1,840,956	4	$191,219
District of Columbia	6	$450,896	3	$323,563
Delaware	5	$1,067,040	0	$0
Florida	17	$1,083,670	2	$87,295
Georgia	13	$1,236,739	0	$0
Hawaii	3	$331,996	0	$0
Iowa	3	$135,687	0	$0
Idaho	4	$474,901	1	$49,246
Illinois	25	$2,538,973	0	$0
Indiana	9	$1,020,681	1	$35,000
Kansas	1	$48,960	0	$0
Kentucky	2	$69,323	0	$0
Louisiana	4	$210,038	0	$0
Massachusetts	205	$22,856,135	21	$1,815,982
Maryland	47	$5,584,248	11	$2,094,666
Maine	7	$321,849	0	$0
Michigan	25	$2,874,007	3	$258,554
Minnesota	14	$1,301,655	0	$0
Missouri	6	$544,150	0	$0
Mississippi	6	$325,317	1	$38,083
Montana	2	$84,316	0	$0
North Carolina	18	$2,674,997	0	$0
Nebraska	3	$593,506	0	$0
New Hampshire	9	$1,557,412	2	$98,775
New Jersey	28	$2,402,812	5	$217,992
New Mexico	15	$1,192,652	1	$375,200
Nevada	2	$88,265	0	$0
New York	45	$4,439,061	9	$737,008
Ohio	49	$5,855,704	12	$1,067,295
Oklahoma	4	$192,356	0	$0
Oregon	22	$2,259,844	1	$49,165
Pennsylvania	51	$5,515,485	1	$499,969
Rhode Island	3	$305,868	0	$0
South Carolina	1	$49,955	0	$0
South Dakota	1	$45,636	0	$0
Tennessee	12	$1,351,130	1	$200,000
Texas	29	$1,762,734	1	$49,988
Utah	21	$1,616,269	0	$0
Virginia	79	$6,852,505	1	$45,480
Vermont	1	$59,871	0	$0
Washington	46	$5,377,178	9	$884,854
Wisconsin	6	$851,089	0	$0
TOTALS	1181[1]	$124,023,793[2]	127[1]	$15,003,248[2]

[1]Distribution excludes 127 Phase I awards and dollars from NASA and 29 Phase II awards and dollars from DOD.
[2]Dollars are higher than actual amount awarded in FY 84 as a result of some agencies including the total dollar value of Phase II awards compared to amount obligated in FY 84.

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EXHIBIT 3-4B
CUMULATIVE GEOGRAPHIC DISTRIBUTION
FY 83 AND FY 84 SBIR AWARDS
PHASE I AND PHASE II

State	Number of Awardees	Dollar Amount	Number of Minority Awards	Minority Dollar Amount
Alabama	33	$3,514,272	11	$1,109,223
Arkansas	2	$273,139	0	$0
Arizona	16	$2,319,473	2	$235,000
California	416	$36,360,929	50	$5,686,454
Colorado	47	$2,840,603	3	$227,464
Connecticut	45	$2,949,922	4	$191,219
District of Columbia	12	$690,211	5	$391,964
Delaware	7	$1,160,040	0	$0
Florida	27	$1,625,241	6	$263,421
Georgia	16	$1,435,424	0	$0
Hawaii	5	$553,692	0	$0
Iowa	3	$135,687	0	$0
Idaho	5	$518,015	1	$49,246
Illinois	37	$3,106,666	1	$34,692
Indiana	16	$1,383,606	1	$35,000
Kansas	2	$158,994	0	$0
Kentucky	3	$118,960	0	$0
Louisiana	5	$280,908	0	$0
Massachusetts	338	$29,990,044	39	$2,892,229
Maryland	88	$7,809,778	24	$2,715,992
Maine	14	$703,832	0	$0
Michigan	37	$3,471,204	4	$295,878
Minnesota	21	$1,580,702	0	$0
Missouri	8	$612,650	0	$0
Mississippi	7	$370,317	1	$38,083
Montana	3	$198,216	0	$0
North Carolina	33	$3,338,996	0	$0
Nebraska	6	$694,995	0	$0
New Hampshire	17	$1,879,557	4	$193,602
New Jersey	42	$3,099,714	10	$432,213
New Mexico	27	$1,850,646	2	$431,200
Nevada	3	$137,987	0	$0
New York	66	$5,505,053	14	$981,886
Ohio	79	$7,376,684	18	$1,373,554
Oklahoma	7	$306,529	0	$0
Oregon	30	$2,660,825	1	$49,165
Pennsylvania	78	$6,795,623	3	$604,337
Rhode Island	6	$471,465	0	$0
South Carolina	1	$49,955	0	$0
South Dakota	1	$45,636	0	$0
Tennessee	24	$1,972,695	1	$200,000
Texas	55	$3,073,182	2	$84,988
Utah	32	$2,142,647	0	$0
Virginia	131	$9,157,306	6	$174,317
Vermont	1	$59,871	0	$0
Washington	78	$7,412,494	15	$1,54,130
Wisconsin	11	$1,056,311	0	$0
TOTALS	1941	$163,250,696	228	$20,235,257

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EXHIBIT 3-5
FY 83/84 SBIR COMPARISONS

Agency	DOA		DOD		DOE		ED		HHS		DOI	
	83	84	83	84	83	84	83	84	83	84	83	84
Solicitations Released	1	1	1	1	1	1	1	1	2	4	1	1
SBIR Budget (000)	$572	1,776	15,366	53,638	5,434	15,616	260	722	6,561	22,327	234	689
Phase I Proposals Received	274	328	2,902	3,010	1,734	844	84	234	792	921	105	110
Total Phase I Awards	16	16	314	368	106	101	8	13	139	226	6	13
Total Minority Disadvantaged Phase I Awards	2	0	48	43	14	11	4	4	16	22	1	1
Total Phase I and Phase II Dollars Awarded (000)	$555	1,678	20,086	44,584	4,985	16,393	311	694	7,301	23,230	208	806
Agency Deficit Surplus (000)	$-22	-97	+ 5,153	-9,054	-252	+ 776	+ 111	-29	+ 664	+ 994	-8.8	+ 116

EXHIBIT 3-5 (continued)
FY 83/84 SBIR COMPARISONS

Agency	DOT		EPA		NASA		NRC		NSF	
	83	84	83	84	83	84	83	84	83	84
Solicitations Released	1	1	1	1	1	1	1	1	1	1
SBIR Budget (000)	$620	2.536	275	915	9.995	13.400	377	1,013.8	5,500	6,04
Phase I Proposals Received	372	366	214	136	977	919	172	110	1,188	977
Total Phase I Awards	6	17	10	10	102	127	7	6	46	102
Total Minority Disadvantaged Phase I Awards	2	1	0	1	13	NA*	0	1	3	3
Total Phase I and Phase II Dollars Awarded (000)	$ 253	1,677	247	852	5,000	13,400	339	1,144	5,173	6,965
Agency Deficit Surplus (000)	$-201	-859	-48	-62	NA	NA**	-2	+130	+327	+361

*At time of reporting NASA had not completed its Phase I awards.
**Deficits Surplus are not included for NASA. NASA SBIR budget is based upon appropriations that are higher than the required SBIR budget.

EXHIBIT 3–6
R&R&D GOALING PROGRAM DATA

	Agency Percent Goal FY 84	OMB FY 84 Total R&D Budget (000)	Dollar Goal (000)	Agency Reported Dollars to Small Business (000)	Percent Awarded to Small Business	Dollars Awarded to Minority/ Disadvantaged (000)	Percent Awarded to Minority/ Disadvantaged (000)
DOA	.3	$867.800	$2.603	$811	.09	NR	NR
DOC	2.8	361.000	10.108	10.712	2.97	$4.842	1.34
DOD	6.6	26.408.200	1.742.941	914.996	3.46	108.476	.41
DOE	88	4.641.800	40.847	46.378	1.0	2.025	.04
DOI	1.6	361.900	5.790	6.291	1.74	668	.18
DOT	37.0	445.600	33.866	48.955	10.99	15.907	3.57
ED	NR	108.700	0	NR	0	NR	0
EPA	12.1	261.100	31.593	33.600	12.87	3.400	1.30
HHS	2.4	4.836.400	116.074	137.414.2	2.84	14.169	.29
NASA	1.2	2.876.600	34.519	37.800	1.3	8.800	.31
NSF	.55	1.202.700	6.615	7.524	.63	851	.07
NRC	1.6	190.700	3.051	3.611	1.89	882	.46
AID	NR	192.400	0	NR	0	NR	0
DOJ	21.3	41.400	8.818	3.100	7.49	740	1.79
HUD	NR	17.200	0	NR	0	NR	0
SI	NR	60.800	0	62	.10	NR	NR
TVA	NR	190.300	0	NR	0	NR	0
TOTALS		$43.136.400	2.038.405	1.254.747		160.970	

NR — Not Reported

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EXHIBIT 3–6
R&R&D GOALING PROGRAM DATA

	DOA		DOC		DOD		DOE		DOI		DOT	
	Number	Dollar Value (000)	Number	Dollar Value (000)	Number	Dollar Value (000)	Number	Dollar Value (000)	Number	Dollar Value (000)	Number	Dollar Value (000)
Awards to Small Business												
Contracts	2	200	135	8,003.4	19,586	914,996	322	53,730.8	75	7,096.6	216	49,304.4
Grants	21	1,483.3	7	456.8	NR	NR[1]	NR	NR	NR	NR[3]	NR	NR
Cooperative Agreements	0	NR	5	NR	NR	NR[2]	NR	NR	NR	NR	NR	NR
Awards to Other Than Small Business												
Contracts	NR	NR	199	23,000.6	15,811	14,749,675	NA	4,448,269.2	192	16,489.8	214	NR
Grants	NR	NR	244	53,693.5	NR	87,000	NR	NR	NR	NR	28	8,440
Cooperative Agreements	NR	NR	156	20,847.2	NR	NR	NR	NR	NR	NR	NR	NR

NA = Not Available
NR = Not Reported

[1]DOD uses grants only for research support at Education installations.

[2]DOD does not use cooperative agreements.

[3]DOI reports it has no system to track grants and cooperative agreements.

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EXHIBIT 3–6
R&R&D GOALING PROGRAM DATA

	EPA		HHS		NASA		NSF		NRC		DOJ	
	Number	Dollar Value (000)	Number	Dollar Value (000)	Number	Dollar Value (000)	Number	Dollar Value (000)	Number	Dollar Value (000)	Number	Dollar Value (000)
Awards to Small Business												
Contracts	15	852.8	373	130,243.7	339	37,800	60	3,875	16	9,265.6	NR	3,100
Grants	NR	NR	283	23,164.9	NR	NR	215	10,614	0	0[1]	NR	NR
Cooperative Agreements	NR	NR	14	1,376.6	NR	NR	NR	NR	0	0[1]	NR	NR
Awards to Other Than Small Business												
Contracts	393	63,400	1,558	14,024.8	689	1,455,160	150	189,000	8	5,820	NR	3,500
Grants	NR	NR	30,721	4,190,872.9	NR	NR	11,900	917,000	13	1,883.7	NR	16,400
Cooperative Agreements	NR	NR	653	95,142	NR	NR	NR	NR	1	635	1,600	NR

[1]All NRC grants and cooperative agreements are provided to other than profit-making organizations.

EXHIBIT 3–6
R&R&D GOALING PROGRAM DATA

	SI		TVA	
	Number	Dollar Value (000)	Number	Dollar Value (000)
Awards to Small Business				
Contracts	NR	NR	31	2,539.7
Grants	NR	NR	NA	NA[1]
Cooperative Agreements	NR	NR	3	217
Awards to Other Than Small Business				
Contracts	NR	NR	13	1,837.1
Grants	NR	NR	NA	NA[1]
Cooperative Agreements	NR	NR	39	29,422.9

[1]TVA does not have a grant program.

No reports received from ED, HUD, AID, VA

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EXHIBIT 3–7
NUMBER OF FY 84 PHASE I AWARDEES WHO RECEIVED AWARDS IN FY 83; EFFECT OF MULTIPLE AWARDS

Number of Companies Receiving Awards in FY 84		Number of These Companies Who Received Awards in FY 83		
		1 Award	Multiple Awards	Total
1 Award	492	52 (11%)	16 (3%)	68 (14%)
Multiple Awards	137	40 (29%)	30 (22%)	70 (51%)
Total	629	92 (15%)	46 (7%)	138 (22%)

EXHIBIT 3–8
NUMBER OF FY 84 PHASE I AWARDEES WHO RECEIVED AWARDS FROM THE SAME AGENCY IN FY 83

	Number of Companies Receiving Awards in 1984	Number Companies Receiving Awards From Same Agency in FY 83
DOD	257	48 (19%)
DOE	94	12 (13%)
NASA	104	21 (20%)
HHS	190	22 (12%)
DOT	17	0 (0%)
DOI	13	1 (8%)
EPA	11	2 (18%)
NRC	5	0 (0%)
ED	11	0 (0%)
DOA	17	1 (6%)

NSF data for Phase I awards in response to the FY 84 solicitation had not been received at the time of publication.

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EXHIBIT 4–1
TECHNOLOGY AREAS

1000 Computer, Information Processing, Analysis

100 Computer and communication systems
- 1110 Computer systems technology
- 1120 Communication and control systems
- 1130 Networks and architectures
- 1140 Computer security

1200 Information processing and management
- 1210 Data and information processing
- 1220 Artificial intelligence
- 1230 Computer software
- 1240 Robotics and automation
- 1250 Man machine interface

1300 Signal and image processing
- 1310 Signal processing
- 1320 Image processing
- 1330 Navigation, guidance, positioning

1400 Systems studies
- 1410 General studies
- 1420 Operations and systems analysis
- 1430 Safety systems, health and risk analysis

1500 Mathematical sciences
- 1510 Math fundamentals
- 1520 Numerical modeling
- 1530 Math modeling

2000 Electronics

2100 Microelectronics
- 2110 Microelectronics, materials, concepts, processing
- 2120 Compound semiconductors
- 2130 Photovoltaics
- 2140 Optoelectronics

2200 Electronics device performance
- 2210 Electronic device performance, packaging, reliability
- 2220 Radiation damage and hardening
- 2230 Testability

2300 Electronic equipment and instrumentation
- 2310 Electronic equipment and systems
- 2320 Data and information processing equipment
- 2330 Sensors, transducers, instrumentation

2400 Electromagnetic radiation propagation
- 2410 RF technology
- 2420 Electronic warfare
- 2430 Target detection
- 2440 Metal and mine detection

2500 Microwave and millimeter wave electronics
- 2510 Microwave electronics
- 2520 Millimeter wave electronics

2600 Optical devices and lasers
- 2610 Optical and IR sensors, components
- 2620 Optical fiber technology
- 2630 Laser technology
- 2640 Higher frequency EM radiation

3000 Materials

3100 Specialty materials, microstructure considerations
- 3110 Metallic, magnetic, high T, conducting & superconducting materials
- 3120 Polymers
- 3130 Ceramics
- 3140 Composites and lightweight materials
- 3150 Construction materials
- 3160 Fire, fabric, and insulation materials
- 3170 EM transparent materials
- 3180 Biomaterials

3200 Materials processing and manufacturing
- 3210 Materials processing
- 3220 Manufacturing methods
- 3230 Joining and welding technology
- 3240 Separation, characterization of multiphases

3300 Coatings, corrosion and surface phenomena
- 3310 Corrosion
- 3320 Coatings
- 3330 Thin films and surfaces

3400 Materials performance
- 3410 Failure, fracture, fatigue
- 3420 Lubrication, wear and seals
- 3430 Repair
- 3440 Non-destructive evaluation

3500 Fundamentals and instrumentation
- 3510 Materials fundamentals/general
- 3520 Instrumentation

4000 Mechanical Performance of Vehicles, Weapons, Facilities

4100 Hydrodynamics
- 4110 Hydrodynamics
- 4120 Watercraft

4200 Aerodynamics
- 4210 Fundamental aerodynamics
- 4220 Aerodynamic performance
- 4230 Aerodynamic facilities, instrumentation

4300 Acoustics
- 4310 Underwater acoustic detection and communication
- 4320 Vibration related acoustics

4400 Mechanical performance of structures and equipment
- 4410 Shock vibration and structural performance of vehicles, facilities, equipment
- 4420 New structural concepts
- 4430 Performance of engine, equipment, mechanical components
- 4440 Weapons performance and effects

4500 Control
- 4510 Control concepts
- 4520 Vehicle/weapon motion controls
- 4530 Structural controls

4600 Mechanical measurements
- 4610 Mechanical measurements (pressure, velocity, etc.)

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EXHIBIT 4–1 (continued)

5000 Energy Convention and use

5100 Transport Sciences
- 5110 Fluid mechanics
- 5120 Flow fluid measurement and enhancement
- 5130 Heat transfer
- 5140 Refrigeration cryogenics

5200 Propulsion combustion technology
- 5210 Propulsion systems
- 5220 Propellants, fuels, explosives
- 5230 Combustion
- 5240 Fire detection
- 5250 Exhaust gases & gas analysis

5300 Large scale energy usage
- 5310 Industrial energy processes and utilization
- 5320 Physics, nuclear physics, fusion and plasma
- 5330 Energy use in buildings

5400 Energy conversion electric power
- 5410 Batteries, fuel cells, electrochemistry, energy storage
- 5420 Alternative energy conversion
- 5430 Electric power technology

6000 Environment & Natural Resources

6100 Ocean science
- 6110 Ocean science and instrumentation

6200 Atmospheric sciences
- 6210 Atmospheric science and monitoring
- 6220 Remote sensing
- 6230 Chemical and biological measurement
- 6240 Particulates and aerosols
- 6250 Pollution abatement and environment control

6300 Water management
- 6310 Water monitoring and characterization
- 6320 Water treatment
- 6330 Water management and utilization
- 6340 Ice, snow, frost detection

6400 Earth Sciences
- 6410 Earth sciences
- 6420 Soil measurement and manipulation

6500 Environmental protection
- 6510 Nuclear, chemical, biological waste management
- 6520 CBR defense

7000 Life Sciences

7100 Medical instrumentation
- 7110 Medical measurements
- 7120 Measurements techniques for radiation imagery
- 7130 Medical devices
- 7140 Devices systems for physicaly impaired

7200 Biotechnology and microbiology
- 7210 Biotechnology and genetic engineering
- 7220 Cellular biology
- 7230 Drugs, vaccines, toxicity, immunology, therapeutic agents
- 7240 Disease detection and screening

7300 Behavioral sciences
- 7310 Behavior, human factors, cognition
- 7320 Training, testing, simulation
- 7330 Social studies

7400 Physiology and miscellaneous
- 7410 Physiological mechanisms, injury, miscellaneous
- 7420 Dental
- 7430 Food, nutrition, agriculture
- 7440 Biotic resources
- 7450 Animal models and veterinary medicine
- 7460 Plant physiology

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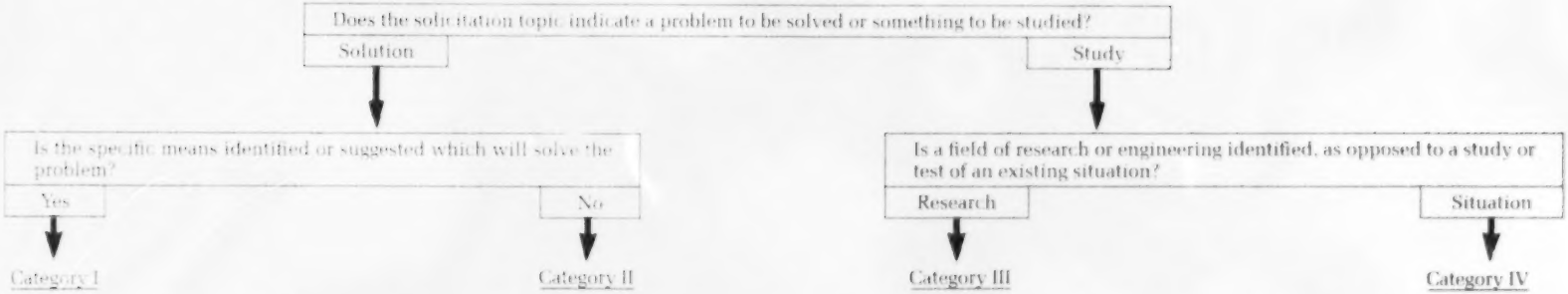
EXHIBIT 4–2
SPECIFICITY CATEGORIES FOR SOLICITATION TOPICS


Does the solicitation topic indicate a problem to be solved or something to be studied?
Solution
Study
Is the specific means identified or suggested which will solve the problem?
Yes
No
Is a field of research or engineering identified, as opposed to a study or test of an existing situation?
Research
Situation
Category I
Category II
Category III
Category IV

The small business responds with an idea on how to produce the product identified. This product is the innovation. To increase the marketing potential the offeror must look for other uses of applications.

The small business responds with an idea as to how to solve the problem. The solution is the innovation. To increase the marketing potential of the resulting product, the offeror would look for similar problems elsewhere.

The small business responds with a plan for research. The link to innovation must come from the offeror. The burden is on the small firm to identify what market needs are addressed by having performed the research.

The small business responds with a study plan—recommendations may or may not lead to innovation. The likelihood for innovation is difficult to see at the outset.

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EXHIBIT 4-3

DOLLAR VALUE (IN THOUSANDS) OF SBIR PHASE I AWARDS RELATED TO TECHNOLOGY AREAS, BY AGENCY, FY 84 AWARDS. (MULTIPLE TECHNOLOGIES ASSIGNED TO EACH AWARD).

($000)

	DOD	DOE	NASA	HHS	DOT	DOI	EPA	NRC	ED	DOA	TOTAL
Computer, Information, Analysis											
Computer, Communication	1,074	162	350	870	100				46	49	2,651
Information Processing	2,151	237	1,000	1,269	50			100	268	44	5,119
Signal Image Processing	2,211	96	250	344	49	28			30		3,008
Systems Studies	2,359	49	150	144	68	55				93	2,918
Math Modelling	1,430	195	150	98	100			99			2,072
Electronics											
Microelectronics	834	299	250		50						1,433
Device Performance	330	50	50	301	50						781
Equipment Instrumentation	1,554	905	500	863	99			50	76	49	4,096
EM Radiation Propagation	1,008										1,008
Microwave MM Wave	558		100								668
Optical Laser	2,679	646	650	799	100		36			49	4,959
Materials											
Special Materials Microscale	2,301	837	800	759	198	104		19		66	5,084
Processing Manufacturing	1,447	812	300	542	50	104	71			95	3,411
Coatings Corrosion	1,280	447	250	382	99						2,458
Performance Fatigue	1,301	440	350		99	32	34	19		47	2,322
Fundamentals Instruments	147	89	50	190							476
Mechanics of Vehicles, Facilities											
Hydrodynamics	73										73
Aerodynamics	230		600		100						930
Acoustics	421		50	50							521
Structural Performance	1,567		300	183		35					2,085
Control	447		300	147				50			944
Measurements	925	50	50	83							1,108
Energy Conversion and Use											
Transport Sciences	1,118	246	1,250	582	50		35	50		99	3,430
Propulsion Combustion	595	750	300	100	100						1,845
Large Scale Uses	162	1,074	100	42	50	27	36			45	1,536
Electric Power	368	298	200	100							966
Environment & Natural Resources											
Ocean Science	48		50			70					168
Atmospheric Science	1,434	514	450	50					49		2,947
Water Management	593		200	50	50	34	144	50		95	1,216
Earth Sciences	235	249				132	249			44	865
Environment Protection	845	740		50							1,635
Life Sciences											
Medical Instrumentation	793	145	50	3,650					90		4,728
Biotechnical Microbiology	214	343		4,311		35	36			163	5,102
Behavioral Sciences	1,290		100	923					239	44	2,596
Physiology & Misc		148	200	866		35				377	1,626

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EXHIBIT 4-4

DISTRIBUTION OF SBIR PHASE I FUNDS AMONG TECHNOLOGY AREAS, FROM EXHIBIT 4.3, FY 84 AWARDS. (MULTIPLE TECHNOLOGY AREAS ASSIGNED TO AWARDS)

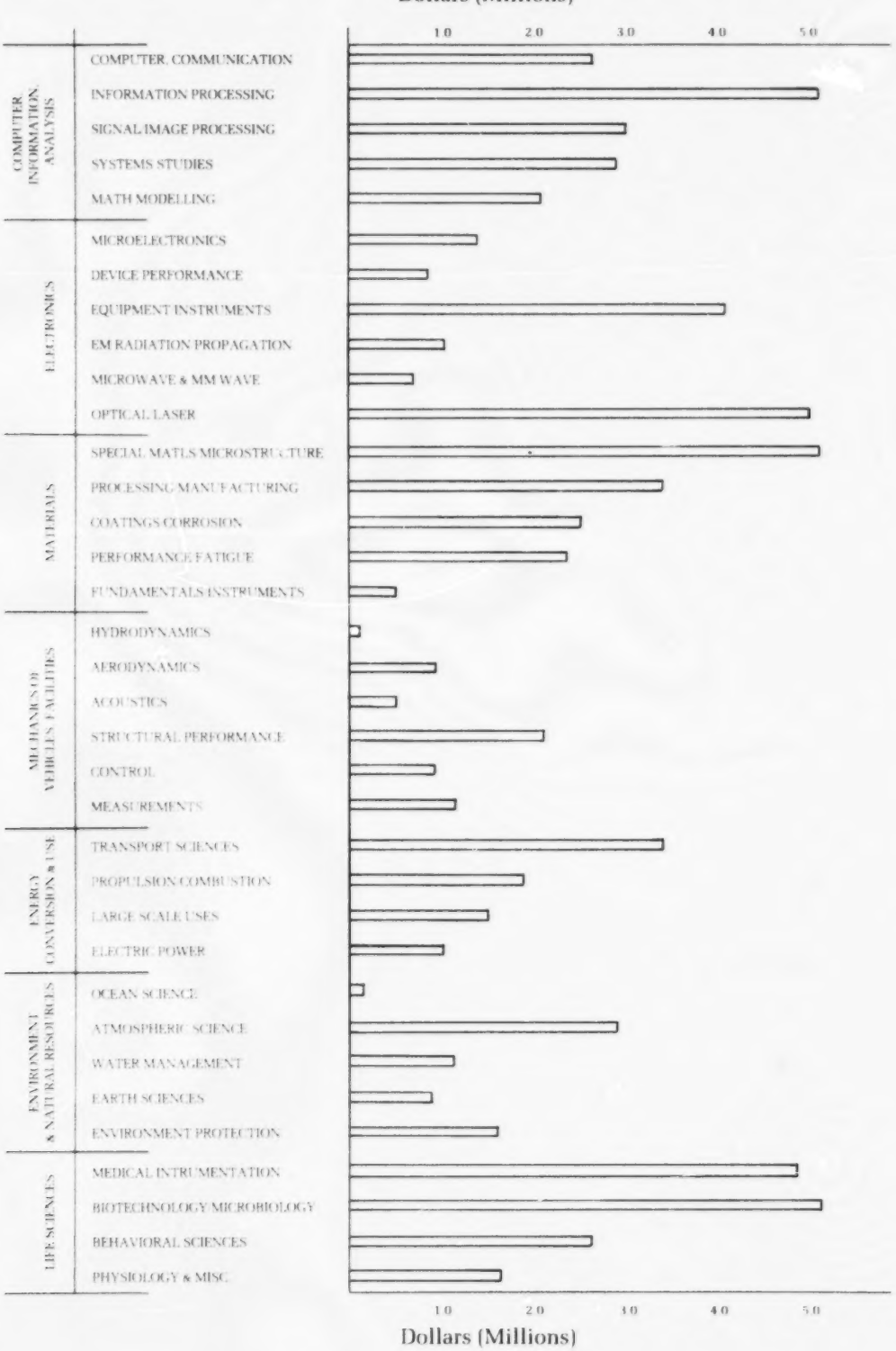

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EXHIBIT 4-5

DOLLAR VALUE (IN THOUSANDS) OF SBIR PHASE II AWARDS RELATED TO TECHNOLOGY AREAS, BY AGENCY, FY 84 AWARDS. (MULTIPLE TECHNOLOGIES ASSIGNED TO EACH AWARD).

($000)

	DOD	DOE	NASA	HHS	DOT	DOI	EPA	NRC	ED	DOA	TOTAL
Computer, Information, Analysis											
Computer, Communication	2,916	500	1,934	1,442	264			235	211		7,502
Information Processing	6,321	2,000	2,758	3,419				392	989		15,879
Signal Image Processing	3,825	750	2,179	3,187	300			235			10,476
Systems Studies	620			93		137		500		100	1,450
Math Modelling	2,726		2,705								5,431
Electronics											
Microelectronics	3,508	775	1,992								6,275
Device Performance	508		497								1,005
Equipment Instrumentation	2,154	4,673	2,812	698	300			235			10,872
EM Radiation/Propagation	1,769				264						2,033
Microwave/MM Wave	1,108		1,499								2,607
Optical/Laser	5,633	2,653	3,353	840		250					12,729
Materials											
Special Materials/Microscale	3,403	2,290	3,520	221			200				9,634
Processing/Manufacturing	3,895	3,937	1,727				300				9,859
Coatings/Corrosion	3,971	1,246	1,736								6,953
Performance/Fatigue	740	2,266	1,762			250					5,018
Fundamentals/Instruments		1,000		800							1,800
Mechanics of Vehicles, Facilities											
Hydrodynamics	442										442
Aerodynamics	345		3,673		300						4,018
Acoustics	672		318		300						1,290
Structural Performance	3,097		1,748		300						5,145
Control	970		251	453						200	2,174
Measurements	457		380								837
Energy Conversion and Use											
Transport Sciences	1,353	1,691	4,766	1,497			100	142			9,549
Propulsion/Combustion	1,561	2,341	3,518								7,420
Large Scale Uses	370	7,079	317				100	142		200	8,208
Electric Power	3,515	1,577	1,251								6,343
Environment & Natural Resources											
Ocean Science	194		500								694
Atmospheric Science	1,805	1,356	976	415			100				4,652
Water Management	542	491	283								1,316
Earth Sciences		980			300						1,280
Environment Protection	400	1,439				137	200				2,176
Life Sciences											
Medical Instrumentation			497	11,093						120	11,710
Biotechnical/Microbiology		822	486	4,655						280	6,243
Behavioral Sciences			500	2,251					360	100	3,211
Physiology & Misc.	428		477	573			100			720	2,298

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EXHIBIT 4-6

DISTRIBUTION OF SBIR PHASE II FUNDS AMONG TECHNOLOGY AREAS, FROM EXHIBIT 4.5, FY 84 AWARDS. (MULTIPLE TECHNOLOGY AREAS ASSIGNED TO AWARDS)

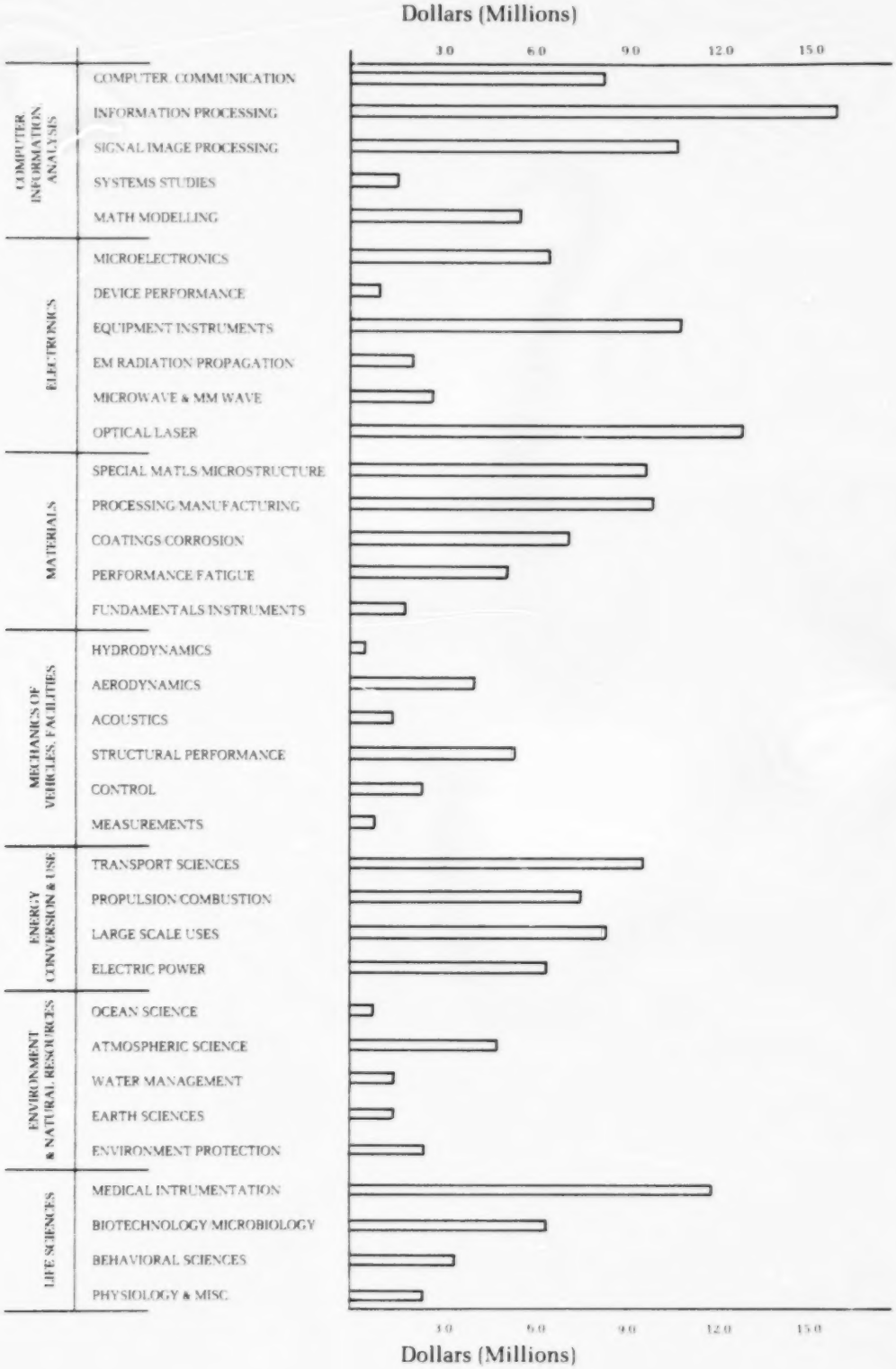

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EXHIBIT 4–7

DISTRIBUTION OF SBIR FY 84 AWARDS COMPARED WITH FY 83 AWARDS USING THE MOST GENERAL TECHNOLOGY AREAS

	FY 83 Phase I		FY 84 Phase I		FY 84 Phase II	
	$000	%	$000	%	$000	%
Computer, Information Processing, Analysis	12,340	21	15,768	21	40,738	22
Electronics	9,890	17	12,945	17	35,521	19
Materials	10,644	18	13,751	18	33,264	18
Mechanical Performance of Vehicles, Weapons, Facilities	3,785	7	5,661	7	13,906	7
Energy Conversion and Use	8,368	10	7,777	6	31,520	17
Environment & Natural Resources	3,281	6	6,831	9	10,118	5
Life Sciences	9,981	17	14,502	18	23,462	12
TOTALS	58,289	100	76,785	100	188,529	100

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EXHIBIT 4-8

COMPARISON OF TECHNOLOGY AREAS FOR FY 84 PHASE I AWARDS WITH TECHNOLOGY AREAS FOR FY 83 PHASE I AWARDS.

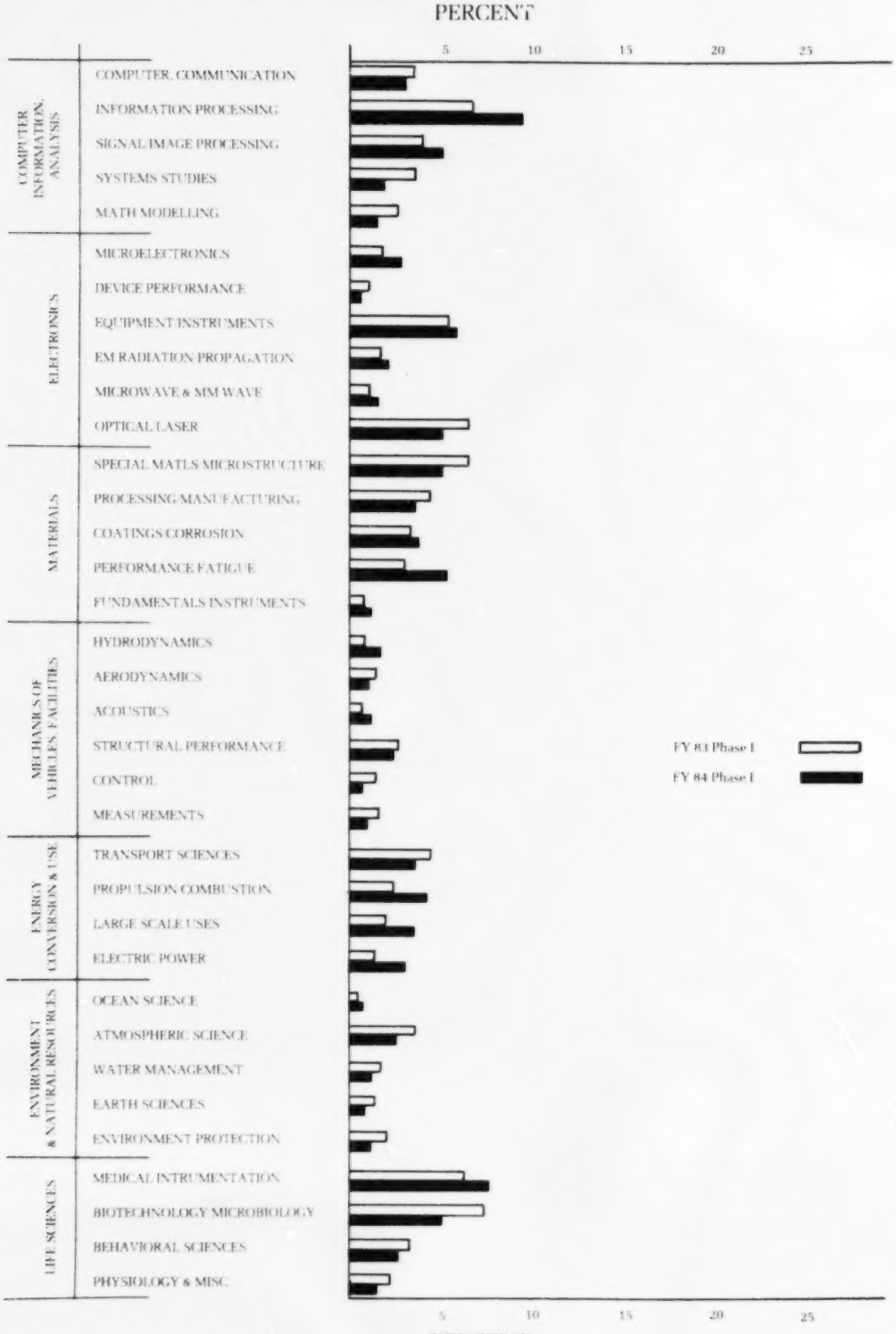

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EXHIBIT 4-9

COMPARISON OF TECHNOLOGY AREAS FOR FY PHASE II AWARDS WITH TECHNOLOGY AREAS FOR FY 83 PHASE I AWARDS.

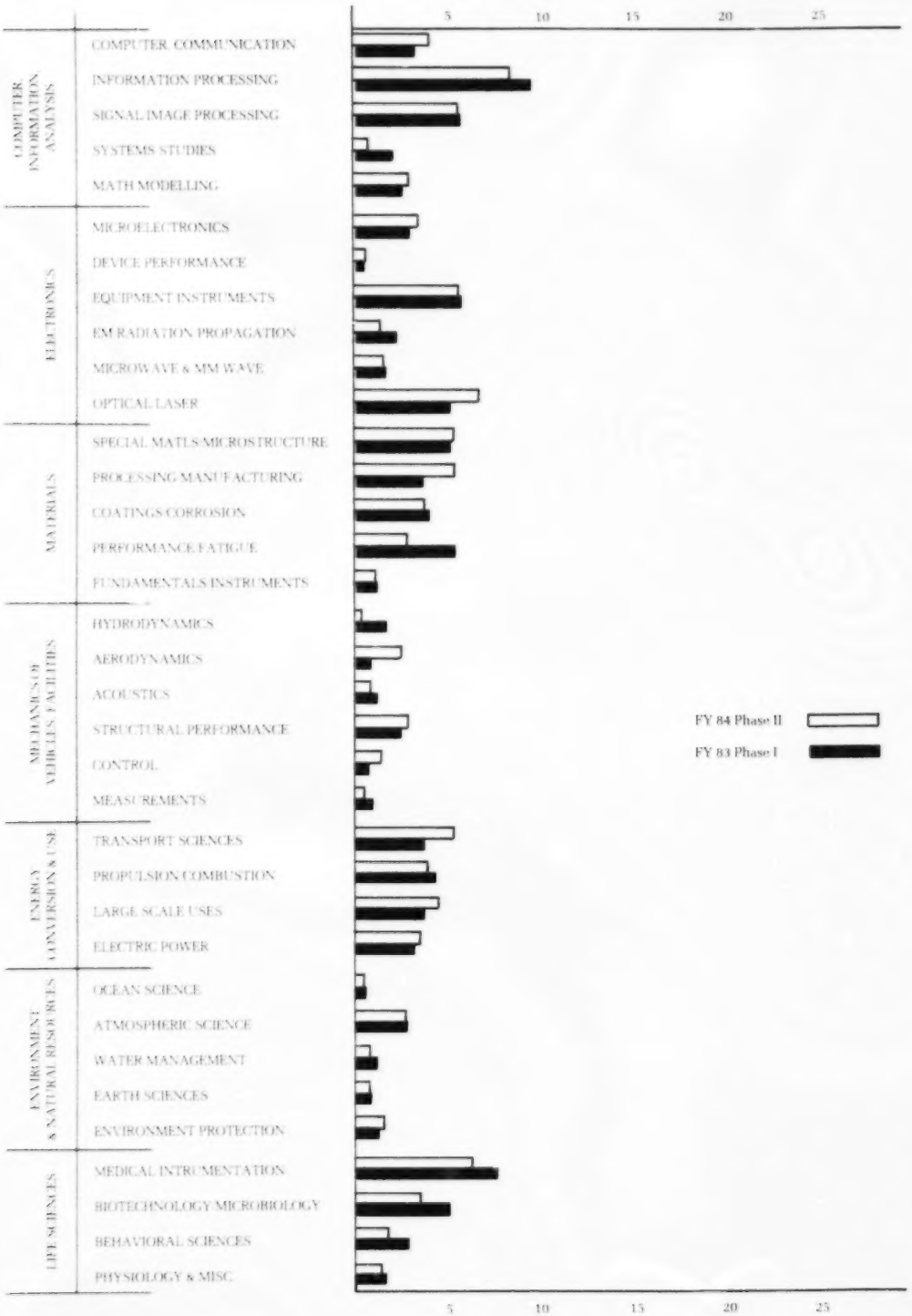

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EXHIBIT 4–10

PERCENT OF VENTURE CAPITAL FINANCING RELATED TO TECHNOLOGY AREAS, 1982–1984 (MULTIPLE TECHNOLOGIES ASSIGNED TO EACH INVESTMENT)

	Percent Total Amount Invested			
	1982	1983	1984	1982–1984
Computer, Information, Analysis				
Computer, Communication	10.7%	12.7%	13.5%	12.4%
Information Processing	24.1	26.4	26.7	25.9
Signal Image Processing	7.8	2.5	4.1	3.0
Systems Studies	0.4	0.3	0.4	0.4
Math Modelling	0.3	0.1	0.0	0.1
Electronics				
Microelectronics	9.0	7.6	10.2	8.7
Device Performance	1.4	1.1	2.7	1.6
Equipment Instrumentation	24.5	27.2	23.3	25.6
EM Radiation Propagation	0.7	0.3	0.2	0.4
Microwave MM Wave	0.3	0.7	0.6	0.6
Optical Laser	3.2	3.4	2.4	3.1
Materials				
Special Materials Microscale	0.6	1.1	1.9	1.2
Processing Manufacturing	2.3	0.7	1.2	1.2
Coatings Corrosion	3.4	2.4	1.7	2.4
Performance Fatigue	0.1	0.0	0.0	0.0
Fundamentals Instruments	0.5	0.5	0.0	0.4
Mechanics of Vehicles, Facilities				
Hydrodynamics	0.0	0.0	0.0	0.0
Aerodynamics	0.0	0.0	0.0	0.0
Acoustics	0.0	0.0	0.0	0.0
Structural Performance	0.3	0.0	0.0	0.0
Control	0.4	0.4	1.1	0.6
Measurements	0.0	0.0	0.0	0.0
Energy Conversion and Use				
Transport Sciences	0.7	0.2	0.4	0.4
Propulsion Combustion	0.3	0.3	0.1	0.2
Large Scale Uses	0.4	0.2	0.0	0.2
Electric Power	1.0	0.8	0.3	0.6
Environment & Natural Resources				
Ocean Science	0.0	0.0	0.0	0.0
Atmospheric Science	0.1	0.3	0.1	0.2
Water Management	0.0	0.0	0.2	0.0
Earth Sciences	1.0	0.4	0.2	0.5
Environment Protection	0.1	0.3	0.2	0.2
Life Sciences				
Medical Instrumentation	3.8	4.6	4.2	4.3
Biotechnology Microbiology	4.3	4.2	2.8	3.8
Behavioral Sciences	0.4	0.5	0.2	0.4
Physiology & Misc.	2.1	1.0	1.3	1.3
TOTALS	100%	100%	100%	100%

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EXHIBIT 4-11

COMPARISON OF TECHNOLOGY AREAS FOR SBIR AWARDS (PHASE I, FY 84) WITH TECHNOLOGY AREAS FOR VENTURE CAPITAL INVESTMENT (1982–1984)

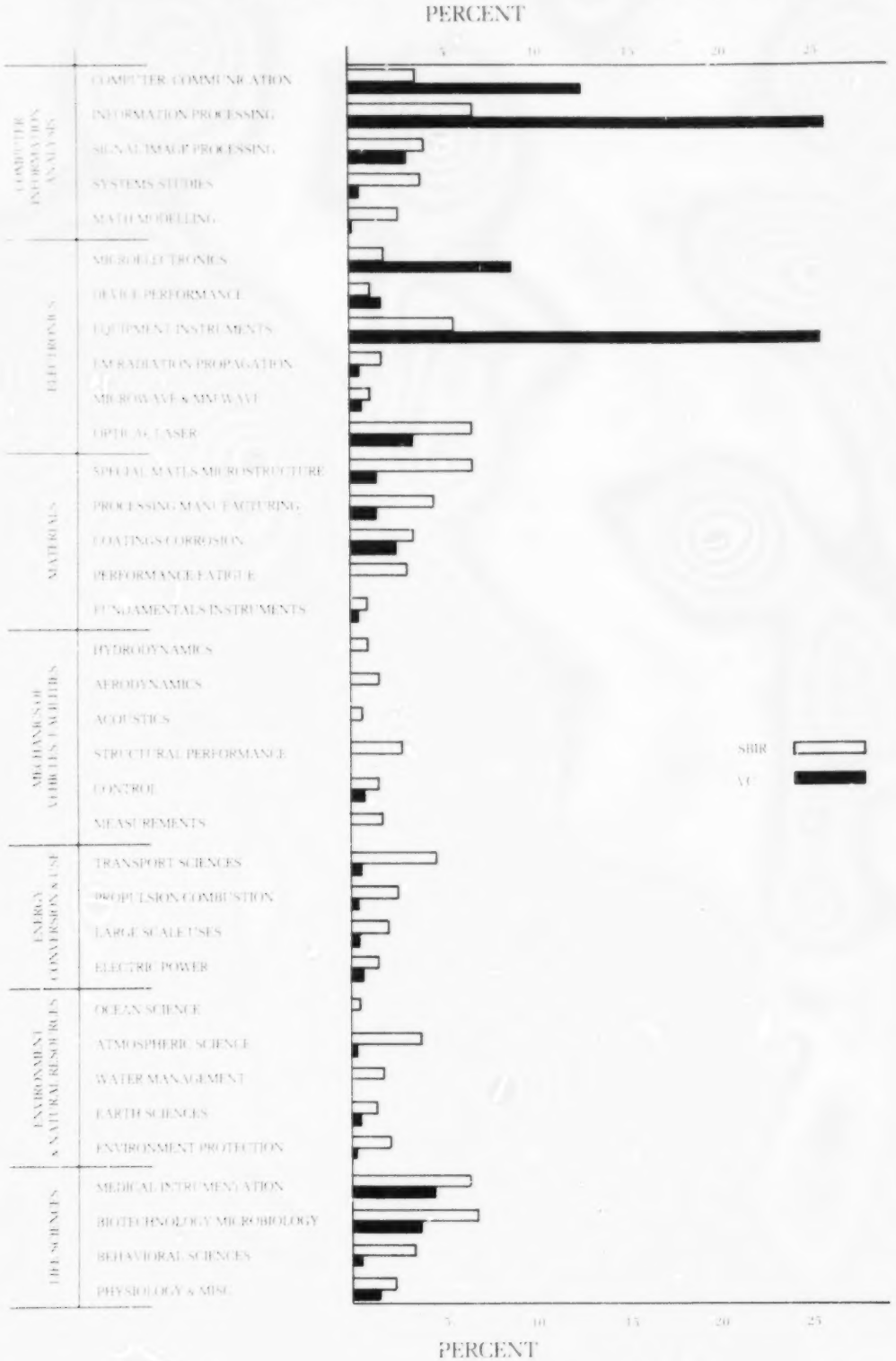

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EXHIBIT 4–12

PERCENT OF SBIR AWARDS (FY 83 AND FY 84) AND VENTURE CAPITAL FINANCING (1982–1984) WITHIN EACH STATE

State	Percent SBIR Awards	Percent of Venture Capital Financing
Alabama	2.2%	0.1%
Arizona	1.4	0.5
Arkansas	0.2	0.0
California	22.3	52.9
Colorado	1.7	3.5
Connecticut	0.8	1.8
Delaware	.7	0.0
District of Columbia	.4	0.1
Florida	1.0	1.6
Georgia	.9	0.2
Hawaii	.3	0.0
Idaho	.3	0.2
Illinois	1.9	1.6
Indiana	.8	0.2
Iowa	.1	0.1
Kansas	.1	0.0
Kentucky	.1	0.0
Louisiana	.2	0.0
Maine	.4	0.1
Maryland	4.8	0.6
Massachusetts	18.3	15.1
Michigan	2.1	1.6
Minnesota	1.0	2.0
Mississippi	.2	0.0
Missouri	.4	0.0
Montana	.1	0.0
Nebraska	.4	0.0
Nevada	.1	0.0
New Hampshire	1.2	0.6
New Jersey	1.9	2.1
New Mexico	1.1	0.0
New York	3.4	2.4
North Carolina	2.0	0.2
Ohio	4.5	0.9
Oklahoma	.2	0.3
Oregon	1.6	2.3
Pennsylvania	4.2	1.6
Rhode Island	.3	0.3
South Carolina	0.0	0.0
South Dakota	0.0	0.0
Tennessee	1.2	0.1
Texas	1.9	4.6
Utah	1.3	0.4
Vermont	0.0	0.0
Virginia	5.6	0.5
Washington	4.5	1.2
West Virginia	0.0	0.1
Wisconsin	.6	0.0

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